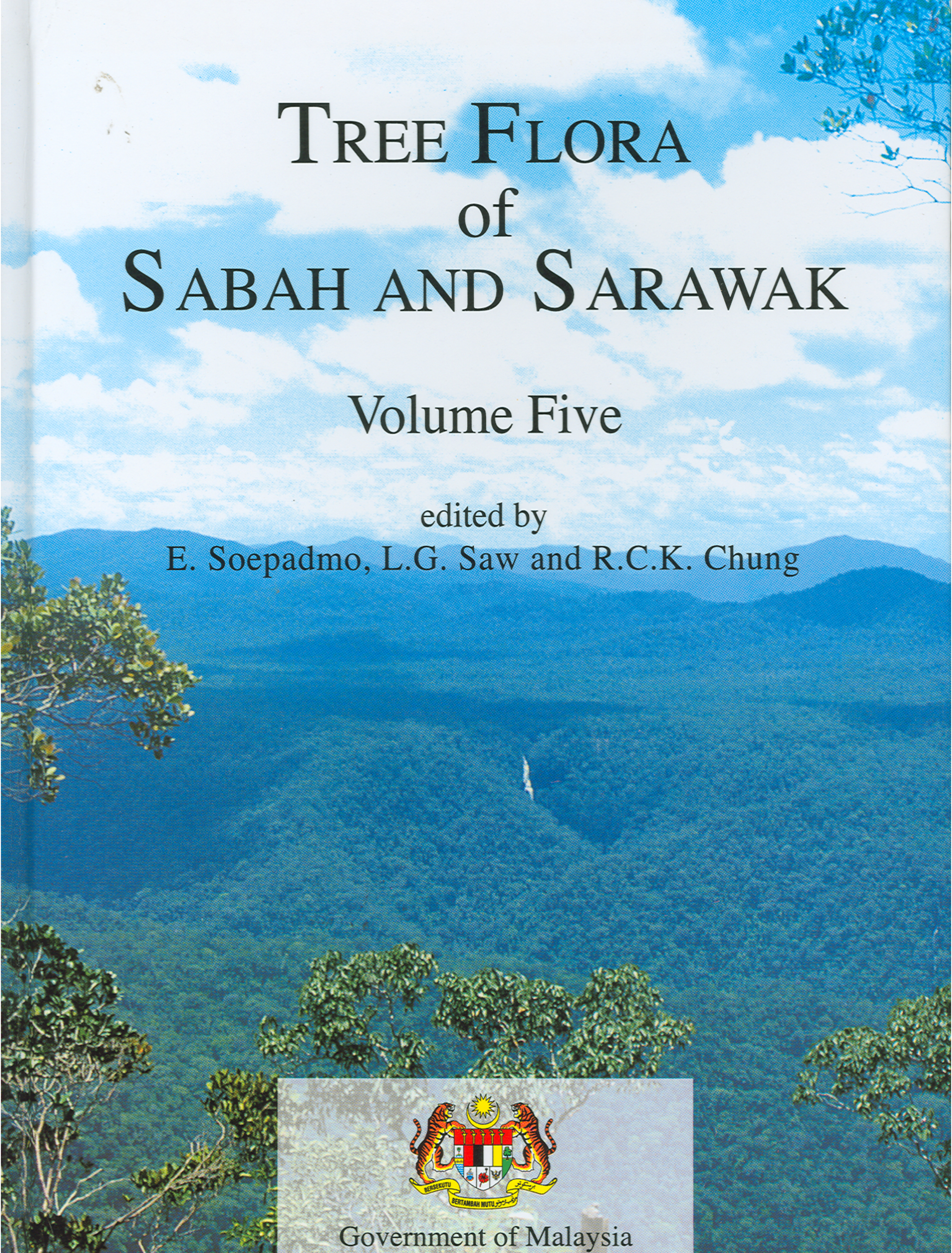

TREE FLORA
of
SABAH AND SARAWAK

Volume Five

edited by
E. Soepadmo, L.G. Saw and R.C.K. Chung

Government of Malaysia

TREE FLORA
of
SABAH AND SARAWAK

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Front cover: Lowland and hill forests on ultramafic soil, Bt. Tawai FR, Sabah. (Photograph by E. Soepadmo.)

Back cover: *Koompassia excelsa* (Becc.) Taub. with new growth. (Photograph by E. Soepadmo.)

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FOREWORD

We are particularly pleased to provide this foreword towards Volume 5 of the Tree Flora of Sabah and Sarawak. Considering the tremendous richness of Borneo's flora, each volume of the Tree Flora of Sabah and Sarawak marks a milestone in botanical science. Volume 5 comes just two years after the publication of Volume 4, a remarkable achievement that reflects the commitment and dedication of all those involved in the Tree Flora project. Like any other project of this nature, adequate funding is necessary. Therefore, we are particularly grateful to the Ministry of Science, Technology and Environment (now the Ministry of Science, Technology and Innovation), for approving a generous research grant to provide the much-needed financial support for the period 2002–2006.

Volume 5 contains four important tree families, *viz*. the Apocynaceae (David J. Middleton, Harvard University, U.S.A.), Dipterocarpaceae (P.S. Ashton, Harvard University, U.S.A. and Royal Botanic Gardens, Kew, U.K.), Symplocaceae (K.G. Pearce, Sarawak) and Thymelaeaceae (C.S. Tawan, Universiti Malaysia Sarawak), covering 373 species in 28 genera. Of the total number of species treated, 211 or about 56.6% are endemic in Borneo, 18 or about 4.8% in Sabah, 32 or about 8.6% in Sarawak, and 7 species are new to science. The account of the Dipterocarpaceae makes Volume 5 particularly significant, being the most structurally dominant tree family, as well as the principal source of commercial timbers from Borneo's natural forest. It will be of special interest to ecologists and foresters alike, and we hope that this account, which also includes information pertaining conservation status of all known dipterocarp species occurring in Sabah and Sarawak, will in some way contribute towards the conservation and better management of this economically important tree family. The project continues to improve the quality of this publication series, and in this volume, together with the usual botanical line drawings, some colour plates of the trees revised are included.

As with previous volumes, we wish to thank the Curators, Keepers and Directors of the Arnold Arboretum of the Harvard University, Herbarium Bogoriense, Botany Department, Natural History Museum, London, Royal Botanic Garden, Edinburgh, Royal Botanic Gardens, Kew, National Herbarium of the Netherlands, Leiden Branch, Herbarium, New York Botanic Garden, New York, Herbarium, Botanische Staatssammlung, München, Department of Plant Sciences, University of Oxford, Singapore Botanic Gardens, Botany Department, Smithsonian Institution, Washington and the

Sabah Parks. Their continual support has been essential to the success of the project. We are also extremely pleased with the close partnership and cooperation amongst the three key forestry institutions involved in the Tree Flora project (i.e. Forest Research Institute Malaysia, Forestry Department of Sabah, and Forestry Department of Sarawak).

Finally, we would like to record our sincere appreciation to the botanists, members of the editorial committee, botanical artists and supporting staff of the project secretariat for their dedication and hard work in producing Volume 5 of the Tree Flora of Sabah and Sarawak.

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E. Soepadmo
L.G. Saw
May 2004 R.C.K. Chung

APOCYNACEAE

David J. Middleton[1]

With contribution by Kade Sidiyasa[2] (*Alstonia*)

Adans., Fam. Pl. 2 (1763) 167; King & Gamble, J. As. Soc. Beng. 74, 2 (1907) 387; Merrill, EB (1921) 494; Ridley, FMP 2 (1923) 320; Masamune, EPB (1942) 617; Browne, FTSB (1955) 60; Backer & Bakhuizen *f.*, FJ 2 (1965) 218; Whitmore, TFM 2 (1973) 3; Cockburn, TS 1 (1976) 13; Anderson, CLTS (1980) 147; Ashton, MNDTS 2 (1988) 16; Corner, WSTM 3rd. edition 1 (1988) 146; Whitmore, Tantra & Sutisna, CLK 1 (1990) 24; Kessler & Sidiyasa, TBSA-EK (1994) 50; Coode *et al.* (eds.), CLBD (1996) 24; Argent *et al.* (eds.), MNDT-CK 1 (1997) 78; Middleton, Fl. Thailand 7 (1999) 1; Beaman *et al.*, PMK 4 (2001) 102.

Trees, shrubs or climbers, rarely herbs; buttresses and/or pneumatophores sometimes present; *latex present*, *this usually white*, *less commonly cream-coloured*, *yellowish or bluish white*. **Indumentum** of simple hairs. **Leaves** *simple*, *opposite or, more rarely*, *verticillate or spirally arranged*, *pinnately veined*, margin entire, rarely crenulate (in Bornean species). **Inflorescences** cymose, corymbose, rarely fasciculate or paniculate, or flowers solitary, terminal or axillary. **Flowers** bisexual, 5-merous, rarely 4-merous (in *Leuconotis*), radially symmetrical or, very rarely, slightly bilaterally symmetrical (in *Allamanda*); calyx mostly of 5 more or less free lobes, sometimes fused into a tube with shortened lobes (in *Voacanga*, *Chonemorpha*), sometimes with glands at the base inside; corolla consisting of a short or long tube and erect or spreading lobes, funnel-shaped, salver-shaped, platter-shaped, trumpet-shaped, urn-shaped or rotate, lobes overlapping to the left or right, more rarely valvate; stamens inserted on the inside of the corolla tube, completely included or exserted from corolla tube throat, anthers dorsifixed, sagittate or ovate, free or adnate to the pistil head, dehiscing by longitudinal slits, sometimes with the base and apex sterile; disk present or absent, if present then of 2 or 5 lobes or an annular ring, crenate or not; ovary superior or, rarely, semi-inferior, of 2 separate carpels united into a common style, a single bilocular ovary or a unilocular ovary; pistil head with a stigmatic base and a 2-cleft apex. **Fruit** a drupe, berry, capsule or follicle, solitary if from a syncarpous ovary or paired if from an apocarpous ovary, sometimes secondarily fused appearing syncarpous (in *Parsonsia*). **Seeds** simple, arillate, winged, with a ciliate margin or with an apical and/or basal coma (hair-tuft).

Distribution. Approximately 400 genera with about 4500 species (including the Asclepiadaceae; see Taxonomy and classification below) found throughout the world but particularly diverse in the tropics. In Sabah and Sarawak, the family is represented by 24 native genera with *c.* 81 native species. In addition, 8 exotic genera with 10 species are cultivated as ornamentals.

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[1] Arnold Arboretum, Harvard University Herbaria, Cambridge, Massachusetts, U.S.A.
[2] Herbarium Wanariset, Balikpapan, Indonesia

Ecology. The Apocynaceae include small scramblers and climbers as well as large forest lianas, shrubs, small trees and large emergent trees. Amongst the tree species, most occur at lower altitudes on well drained soil with two species, *Alstonia pneumatophora* and *Dyera polyphylla*, are confined to swamp forest and *Alstonia spatulata* often in swamp forest. *Cerbera manghas* is a littoral species and *Cerbera odollam* is a riverine species.

Uses. Much has been written on the uses of various species of Apocynaceae. An attempt was made in the early 20th century to see if the latex of various species, especially *Dyera* spp. (*jelutong*), could be commercially produced. For a time, the latex of *jelutong* was an important ingredient of chewing gum. A number of species have limited local uses as timber. Several species of climbers and non-native herbs are used in the pharmaceutical industry. In Sabah and Sarawak, the most commercially important use of species of Apocynaceae is in horticulture, particularly species of *Adenium*, *Allamanda*, *Catharanthus*, *Cerbera*, *Nerium*, *Plumeria*, *Tabernaemontana*, and *Thevetia*.

Taxonomy and classification. The traditional delimitation of the Apocynaceae has been followed here, but purely for the sake of expediency. It is now becoming increasingly accepted that a more broadly delimited Apocynaceae, including the Asclepiadaceae, would more accurately reflect the evolutionary relationships within this group. Endress & Bruyns (Bot. Rev. 66 (2000) 1) have proposed 5 subfamilies within Apocynaceae *s.l.*, *viz*. the Apocynoideae, Asclepiadoideae, Periplocoideae, Rauvolfioideae, and Secamonoideae. The traditionally delimited Apocynaceae *s.s.* includes the Apocynoideae and Rauvolfioideae. The description given above and the key given below includes all the tree, shrub, climber and herb genera which are native or commonly cultivated in Sabah and Sarawak but only from these two subfamilies. There are no trees in the other three subfamilies, the traditionally delimited Asclepiadaceae, in this region. *Alstonia*, *Cerbera*, *Dyera*, *Kopsia*, *Ochrosia*, *Rauvolfia*, *Tabernaemontana*, and *Voacanga* are in the subfamily Rauvolfioideae, which in most of the previous literature is referred to as the later synonym Plumerioideae. *Kibatalia* is in the subfamily Apocynoideae.

Hunteria zeylanica (Retz.) Gardn. *ex* Thwaites and *Spirolobium cambodianum* Baill. have both been mentioned as occurring in Borneo but I have been unable to find a single specimen of either species from there and, consequently, have not included either in this account. *Trachelospermum borneanum* (Miq.) Boerl. is known from Borneo only by two old specimens from Kalimantan and the genus is, therefore, also not included in this key. It would key out at couplet 32 with *Parsonsia* but can be distinguished from *Parsonsia* by having the anthers only slightly exserted, subsessile stamens and two separate carpels in the ovary.

Key to genera

1. Herbs, sometimes with a woody base……………………………………………………

Catharanthus G.Don

(Greek, *katharos* = pure pink; *anthos* = flower; with pure pink flowers)

Gen. Syst. 4 (1837) 95; Plaizier, Med. Landb. Wag. 81-9 (1981) 13.

Erect herb, sometimes with a woody base. Leaves opposite, with glands in the leaf axils and on the interpetiolar ridge. Inflorescences 1–2-flowered, terminal but often appearing axillary. Flowers: sepals without colleters inside; corolla lobes overlapping to the left in bud, mature corolla salver-shaped, constricted at throat;

stamens free from the pistil head, completely included in the corolla tube; disk of 2 narrow lobes; ovary of 2 separate carpels united into a common style, with many ovules per carpel, style filiform with a collared style head. Fruits of paired follicles, many-seeded. Seeds cylindrical, blunt-ended, rugose, without a coma.

About 8 species in the tropics, 7 of which are endemic in Madagascar. One species, *Catharanthus roseus* (L.) G.Don, is cultivated in Sabah and Sarawak.

Woody plants which are trees, shrubs or climbers……………………………………2

2. Trees or shrubs…………………………………………………………………...…3
Climbers…………………………………………………………………………..…19

3. Leaves spirally arranged…………………………………………………………...…4
Leaves opposite or whorled……………………………………………………...…7

4. Leaves narrowly oblong, less than 1 cm wide; cultivated………………………………..

Thevetia L., *nom. cons.*

(Andre Thevet, 1503/04–1592, a French missionary)

Opera Varia (1758) 212.

Small trees or shrubs. Leaves spirally arranged, with glands in the leaf axils. Inflorescences cymose, terminal. Flowers: sepals with glands inside; corolla lobes overlapping to the left in bud, mature corolla funnel-shaped; small corona lobes present above and below stamens inside; stamens completely included in corolla tube, inserted at point at which corolla tube widens, subsessile, anthers attached to each other apically across top of pistil head but not adnate to it, fertile except for acumens; disk smaller than ovary, fleshy; ovary of 2 carpels connate in lower half, then free and uniting again into common style, with several ovules per carpel, style filiform, head with wide bluntly-lobed frill. Fruit a drupe with mericarps united into an obdeltoid shape, laterally compressed; exocarp fleshy; mesocarp stony; endocarps free from each other. Seeds flattened with a small wing, one per mericarp.

About 8 species in tropical America. One species, *Thevetia peruviana* (Pers.) K.Schum., is cultivated in Sabah and Sarawak as an ornamental.

Leaves obovate or elliptic, more than 2 cm wide; cultivated or wild………………...…5

5. Succulent shrub, noticeably thickened at base of trunk; corolla tube wide; anthers with long bristly appendages; cultivated……………………………………………………….

Adenium Roem. & Schult.

(Greek, *adenos* = gland; referring to the presence of glands in the axils of leaves)

Syst. Veg. 4 (1819) 35; Plazier, Med. Landb. Wag. 80-12 (1980) 3.

Succulent shrubs. Leaves spirally arranged, clustered at branch ends, with glands in the axils. Inflorescences thyrsoid. Flowers slightly bilaterally symmetrical; corolla lobes overlapping to the right in bud, mature corolla funnel-shaped; small corona lobes present between corolla lobes; stamens completely included or exserted, inserted at point where tube widens, anthers with a long appendage at the apex, adnate to the pistil head; disk absent; ovary of 2 separate carpels united into a common style, ovules numerous per carpel. Fruits of paired follicles. Seeds many, with a coma at both ends.

About 5 species in tropical and subtropical Africa to Arabia. One species, *Adenium* *obesum* (Forssk.) Roem. & Schutt., is commonly cultivated in Sabah and Sarawak as an ornamental.

Small trees; corolla tube narrow; anthers without long bristly appendages; cultivated or wild……………………………………………………………………………………6

6. Young twigs more than 1 cm diameter; anthers free from each other, inserted at base of corolla tube; cultivated……………………………………………………...……….

Plumeria L.

(Charles Plumier, 1646–1704, a French missionary, explorer and botanist)

Sp. Pl. 1 (1753) 209; Woodson, Ann. Miss. Bot. Gard. 25 (1938) 202.

Trees. Branches thick and fleshy. Leaves spirally arranged; petioles long. Inflorescences cymose, terminal. Flowers: sepals without colleters inside; corolla lobes overlapping to the left in bud, mature corolla funnel-shaped; stamens free from the pistil head, inserted near base of corolla tube, completely included in tube; disk absent; ovary of two separate carpels, ovules numerous per carpel, style short. Fruits of paired follicles. Seeds flat, with a membranous wing.

About 7 species in tropical America. *Plumeria obtusa* L. and *P. rubra* L. are cultivated in Sabah and Sarawak as ornamentals.

Young twigs less than 1 cm diameter; anthers adnate to each other by their appendages at the top, inserted at the middle of corolla tube or higher; cultivated or wild…………... ……………………………………………………………………….…**2. Cerbera**

7. Leaves whorled……………………………………………………………………….…8

Leaves opposite…………………………………………………………………...…13

8. Shrubs or small trees with little clear latex in cut leaves; anthers with a long appendage.

Nerium L.

(Latinised old Greek plant name—*nerion* = oleander; plants growing in damp habitat along river-bank)

Sp. Pl. 1 (1753) 209; Pagen, Agric. Uni. Wag. Pap. 87-2 (1987) 5.

Shrubs or small trees. Leaves in whorls of 3 or, occasionally opposite, with glands in the axils. Inflorescences thyrsoid, terminal or axillary. Flowers: sepals with glands inside; corolla with lobes overlapping to the right in bud, mature corolla funnel-shaped, sometimes doubled, with a corona at the mouth; stamens mostly completely included, inserted at point where tube widens, adnate to the pistil head at base of anther, anthers with twisted terminal appendages; disk absent; ovary syncarpous, bilocular, ovules numerous per carpel, style short. Fruit a follicle, very narrowly oblong; glabrous. Seeds pubescent, oblong, with an apical coma.

One species in S Europe, N Africa and SW Asia. *Nerium oleander* L. is cultivated in Sabah and Sarawak as an ornamental.

Shrubs to large emergent trees with milky latex in the cut leaves; anthers without a long appendage……………………………………………………………………...…9

9. Shrubs with arching stems; flowers trumpet-shaped, more than 5 cm long……………...

Allamanda L.

(Frederik Allamand, ± 1736, a Swiss physician who collected the plant from Surinam in 1770)

Mant. Pl. 2 (1771) 146; Sakane & Shepherd, Revta. Brasil. Bot. 9 (1986) 125.

Climbers or shrubs. Leaves in whorls of 3–5, with glands in the axils. Inflorescences cymose, terminal or axillary. Flowers large and showy; sepals with or without glands inside; corolla lobes overlapping to the left in bud, mature corolla funnel-shaped; stamens weakly coherent to the pistil head, completely included in the corolla tube; disk annular or crenate; ovary glabrous, syncarpous, unilocular with 2 parietal placentas, style filiform, pistil head collared. Fruit a spiny capsule. Seeds smooth, ovoid.

About 14 species in tropical America. *Allamanda cathartica* L. is cultivated in Sabah and Sarawak as an ornamental.

Trees or shrubs, when young then with erect stems; flowers salver- or platter-shaped, less than 2 cm long…………………………………………………………………..…10

10. Intrapetiolar stipules more than 3 mm long; large tree, trunk columnar, unbuttressed; leaf margin weakly crenulate or entire; corolla tube much shorter than lobes; fruit a follicle with winged seeds……………………………………………………**3. Dyera**
Intrapetiolar stipules less than 3 mm long or absent; shrub to large tree, with or without buttresses; leaf margin entire; corolla tube longer than lobes; fruit drupes or of paired follicles with ciliate seeds……………………………………………………..…11

11. Corolla lobes overlapping to the right in bud; fruits of paired follicles containing seeds with one end acuminate or caudate, or drupes with thick fibrous walls or V-shaped drupes with hard walls…………………………………………..…**7. Rauvolfia** (in part)
Corolla lobes overlapping to the left in bud; fruits of paired follicles containing ciliate seeds with rounded ends, or drupes which are either paired or fused and more or less globose………………………………………………………………………..…12

12. Corolla throat densely pubescent; fruit of long paired follicles………………**1. Alstonia**
Corolla throat glabrous; fruit of fibrous or hard drupes……………**6. Ochrosia** (in part)

13. Calyx lobes connate into a tube for at least half their length; seeds with a fleshy aril…..
……………………………………………………………………………**9. Voacanga**
Calyx lobes free except at very base; seeds with or without a fleshy aril…………..…14

14. Leaves with a small flap inside the base of the petiole; flowers without a disc; seeds with a fleshy aril……………………………………………..…**8. Tabernaemontana**
Leaves without a small flap inside the base of the petiole; flowers with a disc; seeds simple or with long hairs at the end……………………………………………………15

15. Cultivated shrubs with delicate branches; flowers in pendulous cymes; seeds with a tuft of hairs pointing back towards the base of the fruit………………………………………

Wrightia R.Br.

(William Wright, 1735–1819, a British physician and botanist)

Mem. Wern. Soc. 1 (1811) 73; Ngan, Ann. Miss. Bot. Gard. 52 (1965) 114.

Shrubs or small trees. Leaves opposite. Inflorescences cymose, terminal. Flowers: corolla lobes overlapping to the left in bud, mature corolla rotate, salver-shaped or funnel-shaped; corona of varying degrees of elaboration usually present, rarely absent or completely adnate to the corolla; stamens inserted at corolla mouth or in tube, strongly exserted from or completely included in corolla tube, anthers adnate to the pistil head; disk absent; ovary of 2 separate carpels united into a common style or of two connate carpels. Fruits of paired or connate follicles, spindle-shaped. Seeds linear, with a coma directed towards the base of the follicle.

About 24 species, distributed in the Old World tropics. One species, *Wrightia religiosa* (Teijsm. & Binn.) Benth., is cultivated as an ornamental shrub in Sabah and Sarawak.

Wild or cultivated trees or shrubs with robust or moderate branches; flowers in erect cymes or inflorescence fasciculate; if seed has a tuft of hairs this is pointing towards apex of the follicle…………………………………………………………………..….16

16. Small trees, most often near the sea; corolla lobes overlapping to the right in bud; fruits very fibrous or stone-hard…………………………………………………………………...
……………….**6. Ochrosia** (in part; rare form of *Ochrosia* without verticillate leaves)
Shrubs to large trees, generally inland; corolla lobes overlapping to the right or left in bud; fruits either follicles or drupes…………………………………………………17

17. Leaf blade papery; corolla lobes overlapping to the left in bud…………………………..
…...**7. Rauvolfia** (in part; rare form of *Rauvolfia verticillata* without verticillate leaves)
Leaf blade coriaceous; corolla lobes overlapping to the right in bud…………………..…18

18. Leaves with or without domatia on the undersurface, uppermost pair not concealing apical bud; flowers in fascicles, stamens attached to the pistil head; fruit of paired follicles; seeds with a long stalk and backward pointing hairs…………...…**4. Kibatalia**
Leaves without domatia on the undersurface, uppermost pair more or less concealing apical bud; flowers not in fascicles; stamens not attached to the pistil head; fruits of paired or solitary drupes, when paired with a hook on one side; seeds simple..**5. Kopsia**

19. Climbers with tendrils formed from modified inflorescences; ovary syncarpous, unilocular……………………………………………………………………………………

Willughbeia Roxb., *nom. cons.*

(Fr. Willughby, 1635–1672, English zoologist)

Pl. Corom. 3 (1819) 77, *t.* 280; Middleton, Blumea 38 (1993) 2.

Woody climbers, producing white latex. Branches bearing tendrils formed from modified inflorescences. Leaves opposite, those of a pair equal, entire, petiolate; colleters absent from leaf axils; blade papery to coriaceous. Inflorescences cymose, axillary and, rarely, terminal, often very short, appearing fasciculate; axes puberulent or glabrous; bracts small, ovate or oblong. Flowers 5-merous, radially symmetrical; sepals connate at the base, lobes free and erect or slightly reflexed; colleters absent; corolla: lobes in bud overlapping to the left forming a cone or cylinder of erect lobes, in mature flowers spreading, ovate, elliptic or oblong, tube cylindric, somewhat inflated around the stamens, or short and inflated; stamen insertion variable, completely included within the tube, free from the pistil head, filament varying in length, anthers ovate to lanceolate, apex acute or obtuse, base rounded; disk absent; ovary single, unilocular, with 2 parietal placentas, glabrous, superior to semi-inferior, style columnar, stigma ellipsoid or cylindric, stigmoid apex as long as or longer than the stigma. Fruit a fleshy berry, spherical, ellipsoid or pear-shaped, few- to many-seeded, indehiscent. Seeds compressed ovoid, without a coma, smooth, with a very thin endosperm and thick horny cotyledons.

Sixteen species in Indo-China and W Malesia. Six species in Sabah; 7 species in Sarawak.

Climbers without tendrils; ovary syncarpous and bilocular or apocarpous……………20

20. Leaves in whorls of three or more…………………………………………………………..

Alyxia R.Br., *nom. cons.* (in part)

(Greek, *halusis* = chain; the fruit shape)

Prod. (1810) 469; Middleton, Blumea 45 (2000) 1.

Climbers. Leaves whorled or, more rarely, opposite, often with an intramarginal vein, usually with few glands in the axils. Inflorescences cymose, sometimes paniculate, axillary and/or terminal. Flowers: sepals without glands inside; corolla lobes overlapping to the left in bud, mature corolla salver-shaped; stamens free from the pistil head, inserted in top half of corolla tube, completely included in tube, anthers ovate, base cordate, fertile for the entire length; disk absent; ovary of 2 separate carpels united into a common filiform style. Fruit a drupe, usually moniliform (= cylindrical but constricted at regular intervals like a string of beads) with one or more subglobose segments, frequently reduced to one in mature fruit, outside somewhat succulent when mature, one-seed per segment. Seeds ovoid, with a horny and deeply ruminate endosperm.

About 106 species, distributed from NE India through S China to Taiwan and southwards through SE Asia to Australia and eastwards through the Solomon Is. out into the Pacific west as far as Henderson Is. and north to Hawaii. In Sabah and Sarawak, six species are known.

Leaves opposite…………………………………………………………………...…21

21. Leaves punctate below (careful observation needed in thickly coriaceous leaves)……22

Leaves not punctate below……………………………………………………..…24

22. Leaves without a strong intramarginal vein………………………………………………

Anodendron A.DC. (in part)

(Greek, *ano* = climbing, *dendron* = tree)

Prod. 8 (1844) 443; Middleton, Blumea 41 (1996) 38; PROSEA 17 (2003) 75.

Climbers or scramblers, with white latex. Leaves opposite, those of a pair equal, petiolate, entire. Inflorescences cymose, often paniculate, axillary and/or terminal. Flowers 5-merous, radially symmetrical; sepals free, colleters axillary; corolla consisting of a narrow cylindrical tube which widens slightly at the point of stamen insertion into the upper tube and then with spreading lobes which are usually narrow oblong or narrow elliptic, rarely ovate, falcate and overlapping to the right in bud; stamens included in the corolla tube, attached in a ring to the pistil head, anthers narrow triangular, apex acuminate, base sagittate, sterile at apex and base; disk annular, 5-dentate or 5-crenate; ovary of 2 separate carpels united into a common style, superior, ovoid, glabrous, ovules numerous, style glabrous, short; pistil head ovoid with a short sharp projection on top. Fruits of paired follicles, divergent or sub-divergent, wide at base, narrowing toward the ends, longitudinally dehiscent. Seeds beaked, grain narrow ovate or elliptic, flattened, glabrous; coma pointing towards end of fruit.

Seventeen species, distributed from India and China northeastwards to Japan and southwards and eastwards through Indo-China to the Solomon Is. and Vanuatu. Eight species occur in Sabah and Sarawak.

Leaves with a strong intramarginal vein…………………………………………..…23

23. Leaves without a small flap on the inside of petiole base; flowers 4-merous; fruit not dehiscent; seeds without a corky aril…………………..…………………………………

Leuconotis Jack

(Greek, *leukos* = white, *notis* = sap; with white sap)

Trans. Linn. Soc. 14 (1823) 121; Leeuwenberg, Syst. Geogr. 72 (2002) 111.

Climbers. Leaves opposite, usually with distantly spaced lateral veins, punctate below; axillary glands absent. Inflorescences cymose, axillary and/or terminal. Flowers 4-merous; sepals with or without colleters inside, outer pair and inner pair sometimes slightly of different sizes; corolla lobes overlapping to the left in bud, open corolla salver-shaped; stamens completely included in the corolla tube, anthers lanceolate, rounded at the base, fertile for the entire length, filaments short, filiform; disk absent; ovary syncarpous, bilocular, with 2–3 ovules in each locule, style short. Fruit a berry, pulpy inside. Seeds with a membranous testa.

Five species in S Thailand and Malesia. Four species are recorded from Sabah and Sarawak.

Leaves with a small flap on the inside of petiole base; flowers 5-merous; fruit dehiscent; seeds with a corky aril…………………………………………………...

Chilocarpus Blume

(Greek, *cheilos* = lip; *karpos* = fruit; with a fruit dehiscing like a pair of lips)

Cat. (1823) 22; Leeuwenberg, Syst. Geogr. 72 (2002) 127.

Climbers. Leaves opposite, distinctly or obscurely punctate below; intrapetiolar stipules present. Inflorescences cymose, axillary and/or terminal. Flowers: bud drumstick-shaped; sepals usually slightly connate at base, without colleters inside; corolla lobes overlapping to the left in bud, mature corolla salver-shaped with the lobes asymmetrical and slanting to the left as viewed from the inside, acuminate; stamens free from the pistil head, completely included in the corolla tube, inserted about middle or in lower half of corolla tube, filaments short and narrow, anthers ovate, base cordate, apex acute, fertile for the entire length; disk absent; ovary syncarpous, unilocular with 2 parietal placentas, ovules numerous, style filiform. Fruit a berry/capsule, fleshy when young, dehiscing into two when mature. Seeds ovoid, with a corky aril.

Thirteen species, distributed in continental SE Asia and Malesia. Ten species occur in Sabah and Sarawak.

24. Domatia present in the axils of lateral veins with the midrib……………………….…25
Domatia absent………………………………………………………………………27

25. Corolla lobes overlapping to the left in bud; fruit weakly to strongly torulose (= constricted at regular intervals)………………………………………………….…………..

Parameria Benth.

(Greek, *para* = close, near, *meros/meris* = parts, portions; with the fruits bunched together resembling a garland of roses)

In Bentham & Hooker *f.*, Gen. Pl. 2 (1876) 715; Middleton, Blumea 41 (1996) 74.

Climbers with white latex. Leaves opposite, those of a pair equal, petiolate, with axillary glands; blade papery to subcoriaceous, entire. Inflorescences cymose, often paniculate, terminal and/or axillary. Flowers 5-merous, radially symmetrical; sepal lobes free, with colleters inside; corolla lobes overlapping to the left in bud, consisting of a narrow tube and a globose head or whole bud ovoid, open corolla salver-shaped to campanulate with the lobes falcate, broad and rounded or oblong and acute to obtuse; stamens completely included within the corolla tube, attached in a ring to the pistil head, filament short, anthers narrow triangular, base sagittate, sterile at apex and base; disc 5-crenate to completely 5 separate lobes; ovary of 2 separate carpels united into a common style, superior, ovoid, densely puberulent on top, ovules numerous, style glabrous, very short; pistil head ovoid with a projection on top. Fruits of paired follicles, long, narrow and strongly to weakly torulose, longitudinally dehiscent. Seeds hirsute, ellipsoid, flattened, with a coma pointing towards the end of the fruit.

Three species, distributed from India and S China to W Indonesia. Two species in Sabah and Sarawak, *viz. Parameria laevigata* (Juss.) Mold. and *P. polyneura* Hook.*f.*

Corolla lobes overlapping to the right or valvate in bud; fruit torulose to spindle-shaped ……………………………………………………………………………………….…26

26. Petiole 2–7 mm long; lateral veins 3–8 pairs; sepals with colleters on the inner surface; seed grain glabrous, long and narrow……………………………………………………….

Baharuia D.J.Middleton

(from a Malay word—*baharu* = new)

Blumea 40 (1995) 445.

Climbers or scramblers, with white latex. Leaves opposite, those of a pair equal, petiolate; blade papery, entire; lateral veins few, strongly ascending; hair-filled domatia present in the axils of lateral veins with the midrib. Inflorescences cymose, terminal and/or axillary, lax. Flowers 5-merous, radially symmetrical, small; sepals free, colleters present in a row on the inside of the base; corolla lobes overlapping to the right in bud, mature corolla urn-shaped to salver-shaped, consisting of a tube and somewhat spreading, narrow, strap-shaped lobes which are strongly bent to the right as viewed from inside; stamens completely included within the corolla tube, attached in a ring to the pistil head at the attachment of the filaments to the anthers, anthers with a short filament, narrowly triangular, apex acuminate, base sagittate, sterile at apex and base; disc 5-dentate or 5-crenate, usually slightly shorter than ovary; ovary of 2 separate carpels united into a common style, superior, ovoid, pubescent. Fruits of 2 parallel or slightly divergent follicles, narrow and torulose, longitudinally dehiscent. Seeds linear, glabrous, unbeaked apex bearing a cream-coloured coma.

One species, *Baharuia gracilis* D.J.Middleton, in Sumatra and Borneo. In Borneo occurring in both Sabah and Sarawak.

Petiole (6–)8–34 mm long; lateral veins 3–16 pairs; sepals without colleters on the inner surface; seed grain pubescent, ellipsoid…………………………………………….

Urceola Roxb. (in part)

(Latin, *urceolus* = urn-shaped; the corolla)

As. Res. 5 (1798) 169; Middleton, Kew Bull. 49 (1994) 760, Blumea 41 (1996) 82.

Climbers with latex. Leaves opposite, those of a pair equal, petiolate, with or without glands in the axils; blade papery to coriaceous, entire. Inflorescence cymose or sometimes paniculate, terminal and/or axillary. Flowers 5-merous, radially symmetrical; sepal lobes free, with a few colleters inside or absent; corolla lobes in bud overlapping to the right or valvate, open corolla urn-shaped to campanulate, lobes triangular or falcate to the right often with a marked projection pointing to the right as viewed from the inside; stamens completely included within the corolla tube, attached in a ring to the pistil head, filament short, anthers narrow triangular, base sagittate, sterile at apex and base; disc annular to 5-dentate; ovary of 2 separate carpels united into a common style, superior, ovoid, densely puberulent on top, ovules numerous, style glabrous, very short; pistil head ovoid with a projection on top. Fruits of paired follicles, very variable in shape, longitudinally dehiscent. Seeds hirsute, ellipsoid, flattened, with a coma pointing towards the end of the fruit.

Sixteen species, distributed from India and China through Indo-China and the Indonesian Archipelago to New Guinea. Five species occur in Sabah and Sarawak.

27. Branchlets densely covered in pale lenticels………………………………………...…28
    Branchlets without lenticels, or with a very few lenticels…………………………..…29

28. Lateral veins clearly ascending, anastomosing or not into an intramarginal vein; anthers with an elongated acumen; seeds with long stalk bearing hairs………………………….

    Strophanthus DC.

    (Greek, *strophe* = twist, turning, *anthos* = flower; with twisting corolla lobes)

    Bull. Soc. Philom. 3 (1802) 122; Beentje, Meded. Landb. Wag. 82-4 (1982) 17.

    Large woody climbers, sometimes forming large shrubs with pendant branches before beginning to climb. Leaves opposite, with axillary glands, the outer two of which appear like small stipules, glabrous. Inflorescences cymose, terminal; bracts mostly persistent. Flowers: sepals with colleters inside; corolla lobes overlapping to the right in bud, sometimes forming a long twisted acumen, tube widening around the middle, corona 10-lobed, inserted at the base of the lobes, the lobes ovate or elongated into narrow tails, glabrous, mature corolla funnel-shaped; stamens completely included in the corolla tube except for long acumen on anthers, filaments short, swollen abaxially, pubescent, anthers narrowly triangular, base sagittate, with sterile area and apex drawn out into a long acumen, adnate to the pistil head; disk absent; ovary of two free carpels, often partly connate at the base, ovules numerous, style glabrous; pistil head with basal frill, 10-lobed. Fruits of 2 divergent follicles, connate at the base. Seeds apically beaked, with a deciduous basal coma and an apical coma, flattened.

    Thirty eight species, distributed in Africa, India, China, SE Asia and Malesia. Two species, *Strophanthus caudatus* (L.) Kurz and *S. singaporianus* (Wall. *ex* G.Don) Gilg, occur in Sabah and Sarawak.

    Lateral veins more or less straight and anastomosing into a strong intramarginal vein; anthers with no elongated acumen; seeds without stalk, hairs in a tuft from seed end…...

    Aganosma (Blume) G.Don

    (Greek, *aganos* = friendly/agreeable, *osme* = odour/fragrance; the flowers)

    Gen. Syst. 4 (1837) 77; Middleton, Kew Bull. 51 (1996) 456. Basionym: *Echites* sect. *Aganosma* Blume, Bijdr. Fl. Ned. Ind. (1826) 1040.

    Climbers, sometimes forming a shrub with arching branches when young. Leaves opposite, usually with an interpetiolar ridge bearing glands. Inflorescences cymose often forming a panicle, terminal, sometimes also axillary. Flowers: sepals narrowly ovate to linear, colleters many to absent inside; corolla lobes overlapping to the right in bud, mature corolla with spreading or erect lobes; stamens inserted near base of corolla tube, filaments short or anthers subsessile, anthers sagittate, with a sterile area, adnate to the pistil head; disk annular or 5-dentate; ovary of two separate carpels united into a common style, ovules numerous, ovary pubescent or glabrous. Fruits of paired follicles, linear. Seeds flattened, with an apical coma.

    Eight species, distributed from India and S China to W Indonesia. One species, *Aganosma marginata* (Roxb.) G.Don., occurs in Sabah.

29. Lateral and intercostal veins fine and forming an anastomosing network; anthers exserted from corolla tube……………….………...………………………………...

    Vallariopsis Woodson

    (resembling the genus *Vallaris*, Apocynaceae)

    Philip. J. Sci. 60 (1936) 228; Rudjiman, Agric. Univ. Wag. Pap. 86-5 (1986) 89.

Climbers. Leaves opposite, those of a pair equal, petiolate; blade papery. Inflorescences cymose, terminal or axillary. Flowers 5-merous, radially symmetrical; sepals with axillary colleters; corolla with lobes in bud overlapping to the right, consisting of a narrow cylindrical part and an upper campanulate part starting at the point of stamen insertion, lobes spreading, falcate; stamens slightly exserted from the corolla tube, attached in a ring to the pistil head, anthers subsessile, narrow triangular, apex acuminate, base sagittate, sterile at apex and base; disk cup-shaped, shorter than the ovary, 5-lobed; ovary of 2 separate carpels united into a common style, superior, ovoid, glabrous, ovules numerous; pistil head ellipsoid. Fruits of paired follicles, long and thin, glabrous. Seeds long narrow linear, glabrous, with a terminal coma pointing towards fruit apex.

One species, *Vallariopsis lancifolia* (Hook.*f.*) Woodson, occurs in Peninsular Malaysia, Sumatra and Borneo. Not yet collected in Sabah or Sarawak but is known from Brunei and W Kalimantan.

Lateral veins usually distinct from intercostal venation and not forming an anastomosing network; anthers included or exserted from corolla tube……………..…30

30. Lateral veins very straight, often anastomosing into an intramarginal vein………..…31

Lateral veins curved-ascending, even if only at the ends, joining into an intramarginal vein or not………………………………………………………………………32

31. Lateral veins at an angle of *c.* 80° from midrib; corolla tube more than 20 mm long; fruits of paired follicles…………………………………………..…………………….

Eucorymbia Stapf

(Greek, *eu* = good, well-developed, *korumbos* = bunch; with flowers borne in well-developed bunches)

In Hooker, Icon. Pl. ser. 4, 28 (1905) *t.* 2764.

Climbers with white latex. Twigs terete or weakly angled, lenticellate; branchlets glabrous. Leaves opposite. Inflorescences cymose, glabrous. Flowers 5-merous, radially symmetrical; sepals deciduous, with colleters inside; corolla lobes overlapping to the right in bud, open corolla salver-shaped, tube narrow at base and widening at stamen insertion, lobes obovate, narrow at base, rounded at apex; stamens sessile, anthers narrowly triangular, apex acute or acuminate, base sagittate, with sterile area, weakly adnate to the pistil head; disk annular, 5-lobed; ovary of two carpels united into a common style, ovules numerous, style filiform. Fruits of paired follicles, spindle-shaped, slightly flattened, densely lenticellate. Seeds elliptic, flattened, without a terminal coma.

One species, *Eucorymbia alba* Stapf., in W Malesia. Uncommon in both Sabah and Sarawak.

Lateral veins at an angle of less than 80° from midrib; corolla tube less than 10 mm long; fruit a berry with a woody wall…………………………………………………..

Melodinus Forst.

(Greek, *melon* = apple, *dinein* = creeper, climber; a creeper/climber with apple-like fruits)

Char. Gen. (1776) 37; Pichon, Mém. Mus. Nat. Hist. Nat. sér 2, 24 (1948) 125.

Climbers. Leaves opposite, without or with a few glands in the axils; venation often raised, lateral veins anastomosing before margin forming an intramarginal vein; petiole base usually meeting across the stem. Inflorescences cymose or often paniculate, axillary and/or terminal. Flowers: corolla lobes overlapping to the left in bud, open corolla funnel-shaped or salver-shaped, with a corona at the mouth; stamens completely included in corolla tube, anthers narrowly elliptic or lanceolate, base very short bluntly sagittate, fertile for the entire length, filaments short, filiform; disk absent; ovary syncarpous, bilocular, with numerous ovules, glabrous, style slender. Fruit a hard-walled solitary berry. Seeds ellipsoid, flattened; surface patterned.

Nineteen species, distributed in SE Asia, Malesia, Australia, and the W Pacific. One species, *Melodinus orientalis* Blume, in Sabah and Sarawak.

32. Stamens exserted from the throat of the corolla; fruit of a single follicle formed from fused carpels……………………………………………………………………………

Parsonsia R.Br., *nom. cons.*

(J. Parson, 1705–1770, English naturalist)

Asclep. (1810) 53; Middleton, Blumea 42 (1997) 193.

Climbers. Leaves opposite, axillary glands present or absent. Inflorescences cymose, axillary. Flowers: sepals with wide deltoid colleters inside; corolla lobes overlapping to the right in bud, elliptic, lanceolate or oblong, mature corolla salver-shaped; stamens inserted near top of corolla tube, exserted, filaments spiral or strongly bent, anthers lanceolate, sagittate, with sterile area, adnate to the pistil head; disk of 5 separate lobes or annular; ovary of two almost separate, closely adnate carpels or syncarpous and bilocular, glabrous, ovules numerous. Fruits of two adnate follicles or a single follicle which splits into two on dehiscence, spindle-shaped, not lenticellate, glabrous. Seeds glabrous, long and narrow, with an apical coma.

About 82 species, occurring in India, China, SE Asia, Malesia, W Pacific, Australia, and New Zealand. Three species occur in Sabah and Sarawak.

Stamens completely included within corolla; fruits of paired follicles or drupes…..…33

33. Corolla lobes overlapping to the left in bud; stamens not adnate to the pistil head; fruit a single drupe or string of moniliform drupes……………………………………..….**Alyxia** R.Br. (in part; uncommon opposite leaved form of *Alyxia reinwardtii* Blume)

Corolla lobes overlapping to the right in bud; stamens adnate to the pistil head; fruits of paired follicles……………………………………………………………………..…34

34. Corolla tube more than 2 times as long as corolla lobes; inflorescences in umbelliform cymes…………....……………………………………………………………………..

Epigynum Wight

(Greek, *epi* = upon, *gyne* = female; with superior ovary)

Icon. Pl. Ind. Orient. (1848) *t.* 1308.

Climbers. Leaves opposite with axillary glands; lateral veins anastomosing before margin. Inflorescence a congested flat-topped panicle formed from terminal and axillary cymes; bracts small. Flowers: sepals with or, rarely, without colleters inside; corolla in bud a narrow tube, bulging around the anthers, and an ovate head, lobes overlapping to the right in bud, tomentose outside, pubescent inside, salver-shaped when open with obovate lobes; stamens with a short filament, inserted in lower half of tube, anthers narrowly triangular, apex acuminate or acute, base sagittate, with sterile area, adnate to the pistil head; disk of 5 separate lobes or appearing annular, glabrous; ovary of 2 separate semi-inferior carpels united into a common style, ovules numerous, style filiform; pistil head long cylindrical, with an acuminate apex. Fruits of paired follicles, spindle-shaped. Seeds consisting of a flattened grain and a coma directed towards the fruit apex, glabrous.

About 6 species, distributed from the Himalayas to Borneo. One species, *Epigynum borneense* Merr., occurs in Sabah and Sarawak.

Corolla tube less than 2 times as long as corolla lobes; inflorescences variable but not in umbelliform cymes...…35

35. Corolla lobes in bud not strongly twisted; ovary pubescent; seeds not elongated at one end………………………………………………………………………………...…36

Corolla lobes in bud strongly twisted; ovary glabrous; seeds elongated at one end…...37

36. Leaves densely pubescent only on the midrib below, or pubescent all over or glabrous; stamens not inserted at the very base of corolla tube; seeds glabrous apart from coma…………………………………………………………………………………

Ichnocarpus R.Br., *nom. cons.*

(Greek, *ischnos* = slender, *karpos* = fruit; with narrow and slender fruits)

Asclep. (1810) 50; Middleton, Blumea 39 (1994) 74.

Climbers or trailers. Leaves opposite. Inflorescences terminal and/or axillary. Flowers: sepals with or without axillary glands; corolla lobes overlapping to the right in bud, asymmetrical with a slant to the right, tube cylindrical or somewhat inflated, widening at the point of stamen insertion and somewhat constricted at throat, mature corolla salver-shaped; stamens inserted at around the middle or in the lower half of the corolla tube, completely included within the tube, filaments short, anthers elliptic or narrowly triangular, apex mucronate or acuminate, base shortly sagittate, with a sterile area, adnate to the pistil; disk of 5 narrow lobes longer than the ovary or entire and 5-dentate; ovary of two separate carpels united into a common style, pubescent, ovules numerous; pistil head globular or cup-shaped, apex a long narrow point or conical. Fruits of paired follicles, linear and narrow, pubescent or glabrous. Seeds unbeaked, narrowly lanceolate or linear, glabrous, with an apical coma.

Twelve species, distributed from Pakistan to Australia. Two species, *Ichnocarpus frutescens* (L.) W.T.Aiton and *I. serpyllifolius* (Blume) P.I.Forst., occur in Sabah and Sarawak.

Leaves pubescent or glabrous below but not densely pubescent only on midrib; stamens inserted at very base of corolla tube; seeds pubescent on grain…**Urceola** Roxb. (in part)

37. Intercostal venation mostly obscure or only weakly visible; calyx not united into a tube at the base; seeds with long stalk and hairs on this stalk….**Anodendron** A.DC. (in part)

Intercostal venation clearly visible; calyx united into a tube at the base; seeds with a stalk but hairy only on the end of the stalk……………………...……………………..

Chonemorpha G.Don, *nom. cons*.

(Greek, *chone* = funnel, *morphe* = form, shape; with funnel-shaped flowers)

Gen. Syst. 4 (1837) 76; Middleton, Novon 3 (1993) 455.

Leaves opposite, axillary glands present. Inflorescence a terminal panicle. Flowers: sepals often connate for large part of length, colleters present inside; corolla lobes overlapping to the right and twisted to the left in bud, lobes obovate, slightly asymmetrical, salver-shaped in mature flower; stamens inserted near base of corolla tube, anthers sessile, sagittate, with sterile area, adnate to the pistil head; disk entire, 5-dentate, shorter than the ovary, glabrous; ovary of two separate carpels united into a common style, glabrous, ovules numerous. Fruits of paired

follicles. Seeds with a long beak topped with a coma directed towards the fruit apex.
About 10 species, distributed in India, China, SE Asia. One species, *Chonemorpha verrucosa* (Blume) D.J.Middleton, occurs in Sabah and Sarawak.

1. **ALSTONIA** R.Br.

(Charles Alston, 1685–1760, a Scottish botanist)

Kade Sidiyasa

pulai (preferred name)

Mem. Wern. Soc. 1 (1811) 75; King & Gamble, J. As. Soc. Beng. 74, 2 (1907) 435; Ridley, FMP 2 (1923) 345; Monachino, Pacific Science 3 (1949) 137; Smythies, CST (1965) 17; Whitmore, TFM 2 (1973) 7; Markgraf, Blumea 22 (1974) 20; Cockburn, TS 1 (1976) 15; Anderson, CLTS (1980) 147; Ashton, MNDTS 2 (1988) 18; Corner, WSTM 3rd. edition 1 (1988) 149; Whitmore, Tantra & Sutisna, CLK 1 (1990) 24; PROSEA 5, 1 (1994) 82, PROSEA 12, 2 (2001) 61; Kessler & Sidiyasa, TBSA-EK (1994) 51; Coode *et al*. (eds.), CLBD (1996) 24; Argent *et al*. (eds.), MNDT-CK 1 (1997) 78; Sidiyasa, Blumea Suppl. 11 (1998) 77; Middleton, Fl. Thailand 7 (1999) 41; Beaman *et al*., PMK 4 (2001) 103.

Small to large trees to 60 m tall; crown in young trees (except in *A. angustifolia* and *A. macrophylla*) pagoda-shaped and with a monopodial appearance; mature trees typically sympodial; *buttresses usually present*, *small to large*, *massive*, *symmetrical or steep*, *or at least fluted at base of the trunk* (pneumtophore roots found in *A. pneumatophora*). **Bark** smooth to very rough, sometimes corky (in *A. angustiloba* and *A. iwahigensis*), grey, or yellowish brown to dull brown; inner bark granular, mostly yellowish outward and whitish inward, with copious white latex (except in *A. angustifolia* and *A. macrophylla*). **Leaves** *in whorls of 3–8*(*–9*), sessile or petiolate, penninerved, *margin entire*; lateral veins vary from very numerous and close to few and distant. **Inflorescences** cymose or corymbose, compound, terminal, usually in whorls of 1–7 (sometimes up to 9), few- to many-flowered. **Flowers** fragrant, *salver-shaped*; corolla white, yellow or pinkish, *lobes overlapping to the left or right in bud*, spreading in open flower, glabrous to densely pubescent outside, *tube longer than the lobes*, almost cylindrical, mostly slightly widened around stamens, *throat densely pubescent*; stamens included, inserted at about ½ to ¾ up from the base of corolla tube, filaments filiform, *anthers without long appendage*, ovate or, rarely, triangular, apex obtuse, acute or, rarely, mucronate; *ovary of 2 free carpels*, superior, glabrous or pubescent, without or with a distinct thickening-like disk at the base. **Fruits** *of paired follicles*. **Seeds** oblong, sometimes elliptic, *ends rounded*, *caudate*, *acute or acuminate*, glabrous or pubescent, *with long brown cilia longer at the ends.*

Distribution. A pantropical genus with about 45 species, predominantly in the Pacific Is. and Malesia. In Sabah and Sarawak, the genus is represented by 7 species.

Ecology. Secondary or primary forests, in various habitats from swamp forest to drier forest types at altitudes to 1700 m.

Uses. Many alkaloids have been isolated from the bark and latex. Henry (1939), cited by

Monachino (Pac. Sci. 3, 2 (1949) 134), listed 11 species of *Alstonia* with positive findings of alkaloids. The wood (except in *A. angustifolia* and *A. macrophylla*) is classified as a lightweight hardwood, suitable for making boxes, crates, coffins, drawing boards, picture frames, maches, furnitures, and handicrafts such as wooden shoes, toys, puppets and masks (*cf.* PROSEA 5, 1 (1994) 82). The bark and latex are used in traditional medicines (*cf.* PROSEA 12, 2 (2001) 61).

Key to *Alstonia* species

1. Inner bark without white latex; leaves with well-spaced lateral veins and forming an acute angle of a maximum of 80° with the midrib; corolla lobes overlapping to the right in bud; seeds acute, acuminate to caudate at one end…………………………………………...…2
   Inner bark with copious white latex; leaves with closely spaced lateral veins almost perpendicular to the midrib; corolla lobes overlapping to the left in bud; seeds rounded at both ends……………………………………………………………………………...…3

2. Leaves mostly in whorls of 3 (sometimes of 4); calyx mostly rusty pubescent, rarely puberulous or glabrescent at the apex outside; corolla lobes suborbicular or ovate, to 2.3 mm long…………………………………………………………………**1. A. angustifolia**
   Leaves mostly in whorls of 4 (sometimes of 3); calyx glabrous or puberulous outside; corolla lobes narrowly ovate to oblong, 3.6–7 mm long……………...…**4. A. macrophylla**

3. Leaves with a distinct intrapetiolar stipule at base of the petiole; corolla pubescent or puberulous outside……………………………………………………...…**6. A. scholaris**
   Leaves without a distinct intrapetiolar stipule at base of the petiole; corolla glabrous outside……………………………………………………………………………...…4

4. Trees with pneumatophore roots; leaves sessile or almost so.………**5. A. pneumatophora**
   Trees without pneumatophore roots; leaves distinctly petiolate, petiole usually slightly winged.……………………………………………………………………………………5

5. Leaves spatulate or sometimes obovate with a rounded apex; inflorescence with a few loose flowers; calyx glabrous outside………………………………………**7. A. spatulata**
   Leaves obovate, elliptic or narrowly so; inflorescence with many and very crowded flowers; calyx pubescent outside…………………………………………………...…6

6. Corolla tube 1–1.7 times as long as corolla lobes; corolla lobes 4–6.5 mm long; fruits (follicles) pubescent…………………………………………………**2. A. angustiloba**
   Corolla tube 1.8–2.8 times as long as corolla lobes; corolla lobes 2.6–4 mm long; fruits (follicles) glabrous……………………………………………………..…**3. A. iwahigensis**

1. **Alstonia angustifolia** Wall. *ex* A.DC. Fig. 1.

(Latin, *angustus* = narrow, *folium* = leaf; with narrow leaves)

Prodr. 8 (1844) 409; King & Gamble *op. cit.* 440; Merrill, EB (1921) 497; Ridley *op. cit.* (1923) 348; Masamune, EPB (1942) 617; Monachino *op. cit.* 159; Browne, FTSB (1955) 65; Smythies *op. cit.* 18; Whitmore *op. cit.* 8; Markgraf *op. cit.* 26; Anderson *op. cit.* 147; Ashton *op. cit.* 20; Corner *op. cit.* 151;

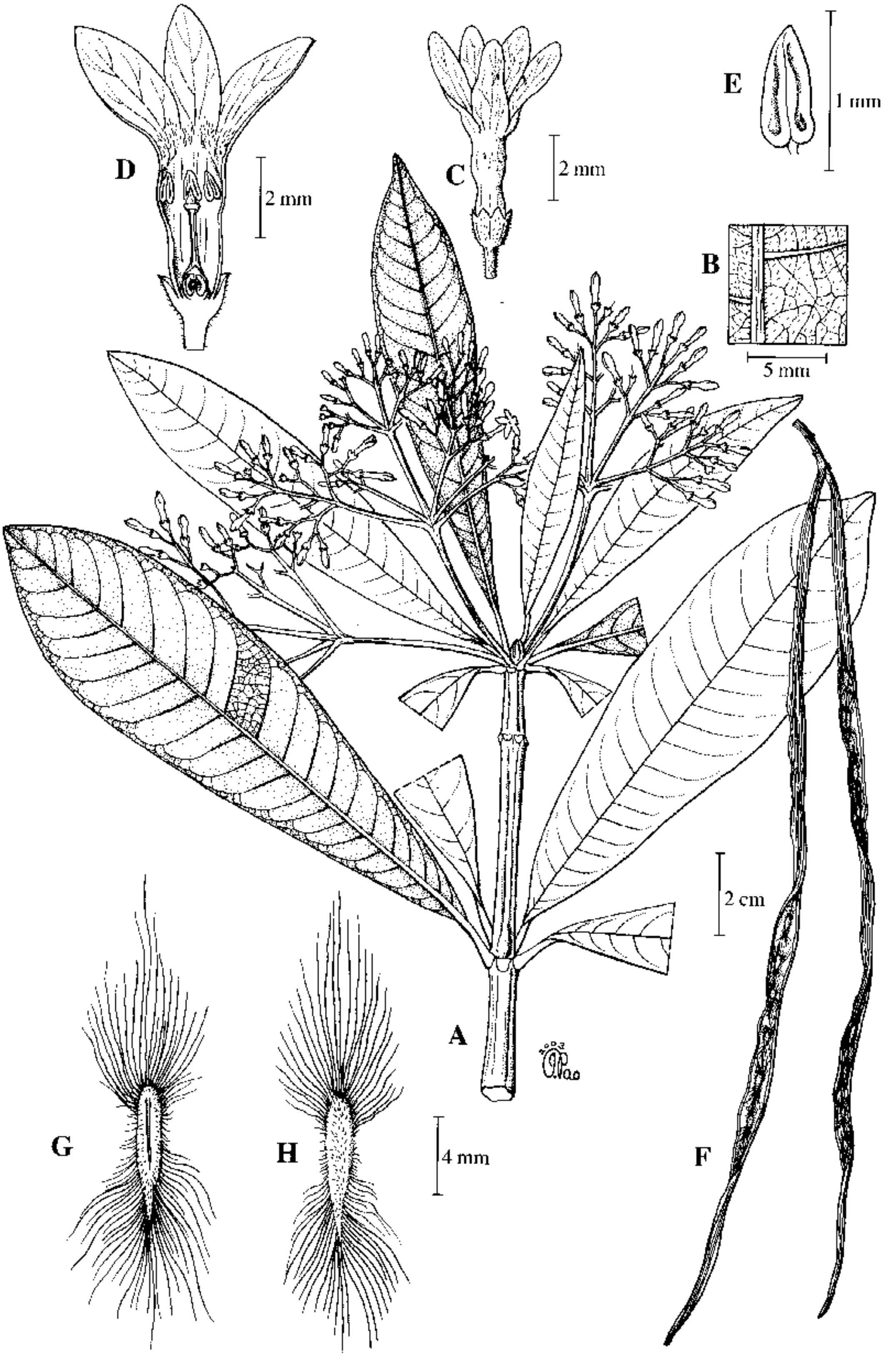

Fig. 1. *Alstonia angustifolia.* A, flowering leafy twig; B, detail of venation on lower leaf surface; C, open flower; D, longitudinal section of open flower; E, stamen; F, dehiscing fruit (follicle); G–H, seeds at different view. (A–E from *SAN 33809*, F–H from *S 18867*.)

Whitmore, Tantra & Sutisna *op. cit.* 24; Kessler & Sidiyasa *op. cit.* 51; PROSEA *op. cit.* (1994) 87, *op. cit* (2001) 65; Turner, Gard. Bull. Sing. 47 (1995) 123; Coode *et al*. (eds.) *op. cit.* 24; Argent *et al*. (eds.) *op. cit.* 79; Sidiyasa *op. cit.* 101; Beaman *et al*. *op. cit.* 103. **Type:** *Wallich 1650,* Singapore (holotype G-DC; isotypes G, K-W). **Synonyms:** *Amblyocalyx beccarii* Benth. *in* Hooker, Icon. Pl. 3, 2 (1876) *t.*1179; *Alstonia angustifolia* Wall. *ex* A.DC. var. *elliptica* King & Gamble *op. cit.* 441; *A. angustifolia* Wall. *ex* A.DC. var. *latifolia* King & Gamble *op. cit.* 441, Kessler & Sidiyasa *op. cit.* 51; *A. latifolia* (King & Gamble) Ridl., *op. cit.* 347, Corner *op. cit.* 151.

Small to medium-sized (rarely big) tree, 5–35(–46) m tall, 8–50 cm diameter, fluted at base or with tall and steep buttresses. **Bark** smooth, shallowly fissured or flaky, grey or brownish, sometimes mottled with grey or greenish lichens; *inner bark* yellowish or straw-coloured, *without white latex*. **Leaves** *in whorls of 3* (*sometimes 4*), chartaceous or thinly coriaceous, mostly dark red-brown when dry, glabrous above, glabrous or puberulous below; blade obovate to narrowly obovate (rarely elliptic), 4–16 × 1.5–5 cm, base acute to narrowly cuneate or decurrent onto the petiole, apex acuminate, acumen *c*. 7(–13) mm long with a blunt point; midrib sunken above; *lateral veins 10–15*(*–20*) *pairs*, *well-spaced*, *forming an acute angle of less than 80° with the midrib*, joinning and forming a fine submarginal vein; intercostal venation reticulate, sometimes conspicuous on both sides; petiole 8–28 mm long, flattened or canaliculate above, slightly winged. **Inflorescences** 3–9 cm long, compound, corymbose, many-flowered. **Flowers** fragrant; pedicels 0.5–2(–3) mm long, pubescent; *calyx rusty pubescent outside*, *and at the apex inside*, apex mostly reflexed; corolla white or pale yellow, 3–5(–6) × 0.8–1.3 mm in mature bud, rusty pubescent outside, or sometimes puberulous or glabrescent around the apex, *lobes overlapping to the right in bud*, *suborbicular or ovate*, *1–2.3 × 1–1.5 mm*, spreading in open flower; ovary ovoid or broadly ovoid, 0.5–0.8 × 0.6–0.7 mm, glabrous; disk 0.1–0.3 mm high. **Fruits** glabrous, 20–53 cm long, 1.7–2.5(–3) mm diameter. **Seeds** elliptic or oblong, (4.6–)6–8.6 × 1.2–1.6 mm, pubescent on both sides, *one end acute with long acumen to 4 mm long*, *the other end rounded*; coma 8–13 mm long, reduced towards the side margins.

Vernacular names. Sarawak—*mergalang* (Iban), *pelai* (Iban), *pelai pipit* (Iban).

Distribution. Sumatra (including Bangka), Peninsular Malaysia, Singapore, and Borneo. In Borneo, widespread in Sabah (e.g., *SAN 32355*, *SAN 64013*, *SAN 85578*, *SAN 85698*, and *SAN 132150*) and Sarawak (e.g., *S 26024*, *S 46018*, *S 48630*, *S 64330*, and *S 76721*). Also occurring in Brunei (e.g., *BRUN 5406*) and in Kalimantan (e.g., *Kostermans 6786* and *Sidiyasa 1425*).

Ecology. Primary and secondary forests, peat swamps, hilly lands, on sandy or granitic soils, at altitudes to 1700 m.

2. **Alstonia angustiloba** Miq.

(Latin, *angustus* = narrow, *lobus* = lobe; the narrow calyx lobes)

Fl. Ned. Ind. 2 (1856) 438; King & Gamble *op. cit.* 438; Merrill *op. cit.* 497; Ridley *op. cit.* 347; Masamune *op. cit.* 617; Monachino *op. cit.* 152; Browne *op. cit.* 63; Smythies *op. cit.* 18; Whitmore *op. cit.* 9; Markgraf *op. cit.* 24; Cockburn *op. cit.* 16; Anderson *op. cit.* 148; Ashton *op. cit.* 22; Corner *op. cit.* 151; Whitmore, Tantra & Sutisna *op. cit.* 25; Kessler & Sidiyasa *op. cit.* 52; PROSEA *op. cit.* (1994) 87, *op. cit.* (2001) 65; Turner *op. cit.* 123; Argent *et al*. (eds.) *op. cit.* 79; Sidiyasa *op. cit.* 104; Middleton *op. cit.* 42. **Type:** *Blume 910*, Java (holotype L). **Synonyms:** *Alstonia calophylla* Miq., *op. cit.* 439; *Paladelpha angustiloba* (Miq.) Pichon, Bull. Mus. Hist. Nat. Paris 2, 9 (1947) 299 (*excl. syn. A. iwahigensis*).

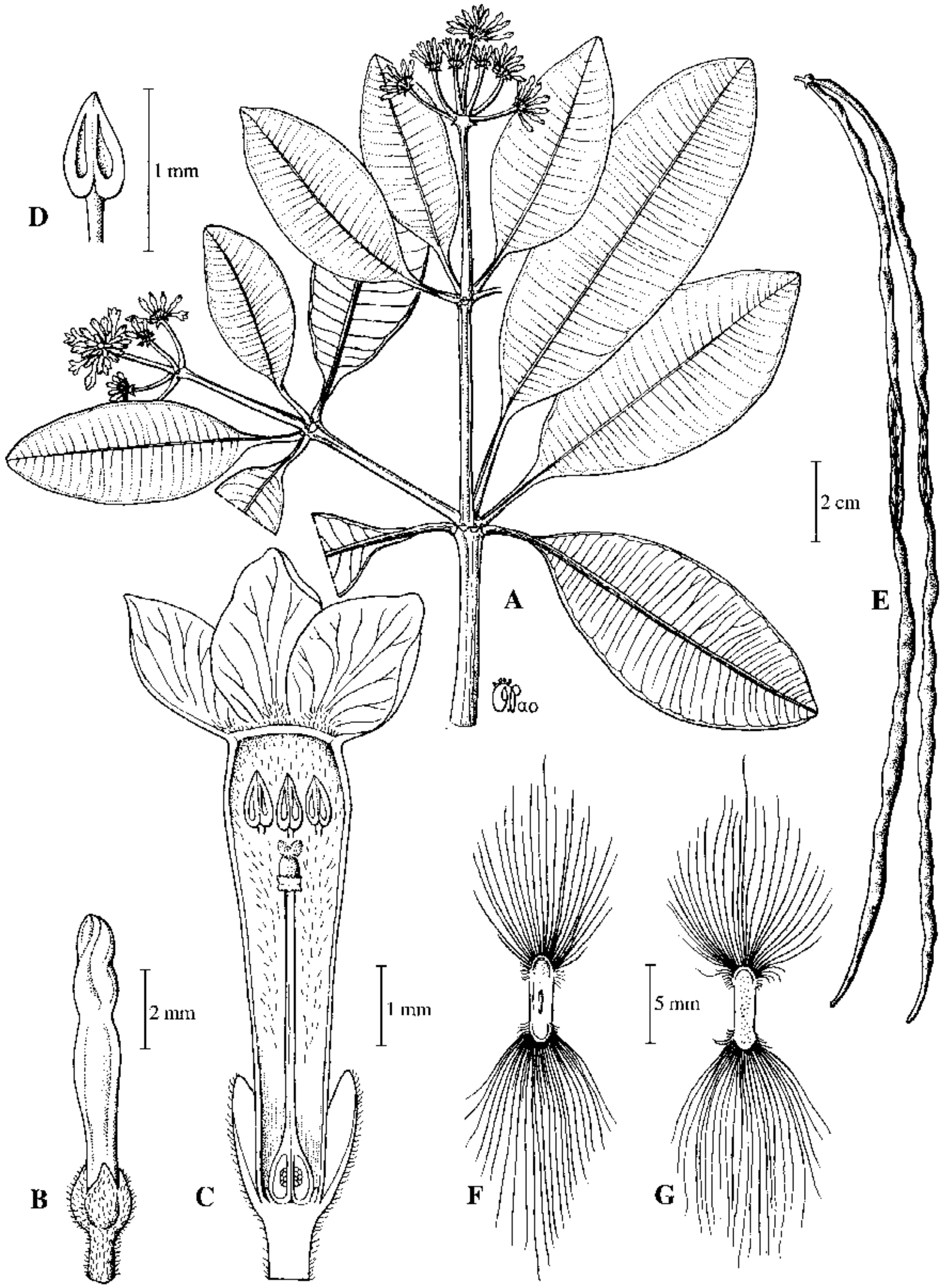

Fig. 2. *Alstonia iwahigensis*. A, flowering leafy twig; B, mature flower bud; C, longitudinal section of open flower; D, stamen; E, dehiscing fruit; F–G, seeds. (A–D from *SAN 72319*, E–G from *SAN 142617*.)

Big tree to 40 m tall, to 60(–100) cm diameter; *bole fluted at the base and forming tall steep buttresses to 8 m high*. **Bark** rough, fissured, or scaly and peeling off in rectangular flakes, greyish or brownish; *inner bark* granular outwards, cream or yellow, *with copious white latex*. **Leaves** in whorls of 4–7(–9), *without distinct intrapetiolar stipule at the base of petiole*, coriaceous, glabrous on both sides, pale to dark brown or blackish above, glaucous to reddish brown below; *blade elliptic*, *obovate or narrowly so* (rarely ovate), 4.5–22 × 2.1–7 cm, base obtuse or acute, apex obtuse, sometimes shortly acuminate with a blunt acumen to 0.6 cm long; midrib sunken above; *lateral veins closely spaced*, *almost perpendicular to the midrib*, 30–60(–70) pairs; intercostal venation inconspicuous; *petiole 7–20*(*–30*) *mm long*, *slightly winged*, flattened and shallowly canaliculate above. **Inflorescences** 3–14 cm long, compound, usually in the form of two nodes of umbellate branches, *many-flowered*. **Flowers** fragrant; pedicels (0–)1–3 × 0.3–0.5 mm, pubescent; *calyx pubescent outside*; *corolla glabrous outside*, white, yellow, or cream, 8–11 mm long in mature bud, *tube 1–1.7 times as long as lobes*, *lobes in bud overlapping to the left*, oblique, ovate, narrowly ovate or oblong, *4–6.5 × 1.6–3 mm*, spreading in open flower; ovary ovoid or broadly ovoid, 0.8–1.1 × 0.8–1 mm, glabrous, sometimes very sparsely hairy around the apex; disk obscure or absent. **Fruits** *brownish pubescent*, 15–35 cm long, 1.6–2.3 mm diameter. **Seeds** oblong, 5–7 × 1.3–1.5 mm, pubescent on the hilar side (except surrounding the hilum which is glabrous), glabrous at the other side, *ends rounded or obtuse*; coma 10–15 mm long.

Vernacular name. Sabah and Sarawak—*pulai bukit* (preferred name).

Distribution. Thailand, Sumatra, Peninsular Malaysia, Singapore, Java, and Borneo. In Borneo, found only in the western parts of Sarawak (e.g., *S 19497*, *S 21587*, *S 28937*, *S 65659*, and *S 73307*) and in Kalimantan (e.g., *bb. 31968* and *Kostermans 11140*).

Ecology. Primary and secondary forests, on hillsides, along streams, swampy areas (usually at the edges), on loamy or sandy soils and on limestone, at altitudes to 200 m.

Uses. The latex is used as a medicine to treat boils and abscesses (*Mamit S 35874*).

3. **Alstonia iwahigensis** Elmer Fig. 2, Plate 1A.

(of Iwahig on Palawan Is., the Philippines)

Leafl. Philip. Bot. 4 (1912) 1447; Sidiyasa *op. cit.* 135; Beaman *et al. op. cit.* 103; PROSEA *op. cit.* (2001) 66. **Lectotype** (Sidiyasa, 1998)**:** *Elmer 13167*, the Philippines, Palawan Is., Puerto Princesa, Mt. Pulgar (lectotype L; isolectotypes A, BO, G, HBG, MO, US, Z).

Medium-sized to large tree, 15–45 m tall, 20–100 cm diameter; *bole fluted at base and forming tall buttresses to 6 m high*, *to 2 m out*. **Bark** smooth to slightly rough, scaly or both longitudinally and horizontally fissured, greyish, yellowish or dark brown; *inner bark* yellow or pale yellow, or yellowish brown inside and brown outside, *with copious white latex*. **Leaves** in whorls of 4–7, *without a distinct intrapetiolar stipule at the base of petiole*, thinly coriaceous, greyish (glaucous) to pale brown below, glabrous on both sides; *blade elliptic to narrowly elliptic or obovate*, 3.5–15.2 × 1.5–4.8 cm, base acute, obtuse or rounded, apex obtuse or rounded, sometimes shortly acuminate; midrib sunken above; *lateral veins closely spaced and almost perpendicular to the midrib*, 25–40 pairs; intercostal venation somewhat conspicuous above; *petiole* (*5–*)*10–28 mm long*, *slightly winged*, flattened and shallowly canaliculate above. **Inflorescences** 2.5–10 mm long, compound, *forming two bunches of many and densely clustered flowers*. **Flowers** fragrant; pedicels 0–1 mm long (very short or flowers sessile), pubescent; *calyx puberulous or pubescent outside*; *corolla* yellow or pinkish, 8–10 mm long in mature bud, *glabrous outside* or only sparsely ciliate around the apex, *tube 1.8–2.7 times as long as lobes*, *lobes overlapping to the left in bud*, ovate, mostly slightly oblique, *2.6–4 × 1.3–2.8 mm*, spreading in open flower; ovary ovoid or broadly ovoid, 0.8–1.1 × 0.7–1 mm, glabrous; disk obscure or absent. **Fruits** *glabrous*, 25–35 cm long, *c.* 1.5(–2) mm diameter. **Seeds** oblong, 5–6 × 1 mm, *ends rounded*, glabrous on both sides; coma 13–17 mm long.

Vernacular names. Sabah—*tombailik* (Bundu Tuhan), *tomboilik* (Dusun, Papar).

Distribution. Borneo and the Philippines (Palawan Is.). In Borneo, common in Sabah (e.g., *SAN 30938*, *SAN 100024*, *SAN 127050*, *SAN 133976*, and *SAN 142617*) and Brunei (e.g., *Niga NN 184* and *BRUN 5005*). There are no known collections from Sarawak but the species is likely to occur in Limbang and Lawas districts. Also occurring in Kalimantan (e.g., *Sidiyasa 474*, *Sidiyasa 1432*, *Kostermans 6456*, and *Kostermans 9559*).

Ecology. Primary and secondary forests, on hillsides, on loamy or sandy soils, at altitudes to 500 m.

Notes. This species has previously mostly been treated as a synonym of *A. angustiloba*. Although difficult to tell apart when sterile, they differ in the pubescence of the fruits and in the length ratio of the corolla tube to the corolla lobes.

4. **Alstonia macrophylla** Wall. *ex* G.Don Plate 1B.

(Greek, *makro* = long or large, *phullon* = leaf; with large leaves)

Gen. Syst. 4 (1837) 87; King & Gamble *op. cit.* 439; Merrill *op. cit.* 497; Ridley *op. cit.* 347; Masamune *op. cit.* 617; Monachino *op. cit.* 164; Whitmore *op. cit.* 9; Markgraf *op. cit.* 28; Cockburn *op. cit.* 18; Corner *op. cit.* 151; Whitmore, Tantra & Sutisna *op. cit.* 25; PROSEA *op. cit.* (1994) 88, *op. cit.* (2001) 66; Turner *op. cit.* 123; Argent *et al.* (eds.) *op. cit.* 79; Sidiyasa *op. cit.* 149; Middleton *op. cit.* 44; Beaman *et al. op. cit.* 103. **Type:** *Wallich 1648*, India, Hort. Bot. Calcutta (holotype K-W). **Synonyms:** *Alstonia macrophylla* ß *glabra* A.DC., *op. cit.* 410; *A. pangkorensis* King & Gamble *op. cit.* 442.

Small to big tree, 3–40 m tall, 5–50 cm diameter, with small buttresses. **Bark** smooth, grey or brownish; *inner bark* cream or straw-coloured and with broken orange laminations, *without white latex*. **Leaves** *usually in whorls of 4* (*sometimes of 3*, *especially on flowering branchlets*), chartaceous or thinly coriaceous, glabrous above, glabrous to pubescent below; blade narrowly obovate, sometimes obovate or narrowly elliptic, 10–28 × 2.5–6(–9.3) cm (on sterile materials the size can be much larger to 40 × 12 cm), base narrowly cuneate to cuneate or decurrent into the petiole, apex shortly acuminate, acumen to 10(–20) mm long; midrib sunken above; *lateral veins well-spaced*, *forming an acute angle of less than 80° with the midrib*, 13–25(–31) pairs; submarginal vein present; intercostal venation reticulate, mostly incospicuous above; petiole (3–)10–35 mm long, canaliculate above. **Inflorescences** 2.5–11 cm long, compound, many-flowered. **Flowers** fragrant; *calyx glabrous or puberulous outside*, *glabrous inside* (*around the* *apex sometimes laxly puberulous*), ciliate; corolla white, 7–10 × 0.9–1 mm in mature bud, glabrous or very sparsely hairy on the apical part outside, *lobes overlapping to the right in bud*, *narrowly ovate or oblong*, sometimes slightly falcate, *3.6–7 × 1–2.6 mm*, spreading in open flower; ovary ovoid, 1–1.4 × 0.7–1 mm; thickening-like disk 0.3–0.4 mm high. **Fruits** glabrous, 20–40 cm long, (1.5–)2–2.5 mm diameter. **Seeds** elliptic or oblong, 6–8 × 1.6–2 mm, pubescent on both sides, *one end long-acuminate with an acumen to 2 mm long* (which is sometimes bifid at the apex), the other end rounded; coma 6–10 mm long, reduced towards the side margins.

Vernacular names. Sabah—*mangalang* (Kota Belud), *pulai daun besar* (preferred name), *sayongan* (Bajau, Bum-Bum Is.).

Distribution. Sri Lanka, India (Nicobar Is.), Thailand, Cambodia, Vietnam, Sumatra, Peninsular Malaysia, Borneo, the Philippines, Maluku, and New Guinea. In Borneo, common in Sabah (e.g., *SAN 25756*, *SAN 64145*, *SAN 89387*, *SAN 132068*, and *SAN 261300*) but not yet reported from Sarawak.

Ecology. Primary and secondary forests, on sandy, loamy or on ultrabasic soils, edge of mangrove and *kerangas* forests, at altitudes to 500 m.

5. **Alstonia pneumatophora** Backer *ex* Den Berger

(Greek, *pneumatophorus* = bearing knee-shaped breathing roots)

Meded. Proefst. Thee 97 (1926) 153; Monachino *op. cit.* 153; Smythies *op. cit.* 18; Anderson *op. cit.* 148; Whitmore *op. cit.* 11; Markgraf *op. cit.* 25; Ashton *op. cit.* 22; Whitmore, Tantra & Sutisna *op. cit.* 25; Kessler & Sidiyasa *op. cit.* 52; PROSEA *op. cit.* (1994) 88; Turner *op. cit.* 123; Argent *et al.* (eds.) *op. cit.* 81; Sidiyasa *op. cit.* 165. **Lectotype** (Sidiyasa, 1998)**:** *Boschproefst.* (*Endert*) *28E IP. 505*, Sumatra, Palembang, Banyuasin (hololectotype L; isolectotypes BO, P, U).

Large tree, 25–55 m tall, 30–100(–200) cm diameter; bole fluted at base and forming tall steep buttresses to 8 m high, to 3 m out; *pneumatophore roots well-developed*. **Bark** smooth or sparsely scaly, grey or yellowish grey; *inner bark* pale yellow or orange-brown, soft, granular, *with copious white latex*. **Leaves** in whorls of (3–)4–6, *sessile or shortly petiolate*, *without a distinct intrapetiolar stipule at the base of petiole*, subcoriaceous, grey-green above, brownish or dark red-brown below, glabrous on both sides; blade spatulate, sometimes obovate, 4.3–13 × 1.5–4.2 cm, base acute or tapering narrowly and evenly right down the petiole, rarely obtuse, *apex* rounded, sometimes retuse; midrib sunken above; *lateral veins closely spaced and almost perpendicular to the midrib*, 18–30 pairs; intercostal venation inconspicuous. **Inflorescences** 3–10 cm long, compound, forming two bunches of densely clustered flowers. **Flowers** fragrant; calyx pubescent outside, ciliate; *corolla glabrous outside*, white, 9–13 × 1–1.6 mm in mature bud, *lobes overlapping to the left in bud*, ovate, 3–4.3 × 2–3.2 mm, not ciliate, spreading in open flower; ovary ovoid, 0.8–1.2 × 0.7–0.9 mm, glabrous; disk obscure or absent. **Fruits** *pubescent*, 10–20 cm long, 1.5–2 mm diameter. **Seeds** oblong, 4–4.8 × 1–1.2 mm, *ends rounded*, glabrous on both sides; coma 8–12 mm long.

Vernacular names. Sabah—*pulai lilin* (Beaufort). Sarawak—*pulai paya* (preferred name).

Distribution. Sumatra, Peninsular Malaysia, Singapore, Borneo, and Sulawesi. In Borneo, common in its suitable habitat in Sabah (e.g., *SAN 42556*, *SAN 73764*, *SAN 89352*, *SAN 139744*, and *SAN 140181*), Sarawak (e.g., *Haviland 1689*, *S 551*, *S 552*, and *S 16414*), Brunei (e.g., *BRUN 48167*), and Kalimantan (e.g., *bb. 4961*, *bb. 1299*, *bb. 502*, *bb. 19853*, and *Kostermans 4537*).

Ecology. Swampy areas, on periodically inundated habitats along stream, on sandy loam or heavy loam soils, at altitudes to 50 m.

6. **Alstonia scholaris** (L.) R.Br.

(Latin, *schola* = school; pertaining to a school)

Mem. Wern. Soc. 1 (1811) 76; King & Gamble *op. cit.* 436; Merrill *op. cit.* 498; Ridley *op. cit.* 346; Masamune *op. cit.* 617; Monachino *op. cit.* 146; Smythies *op. cit.* 20; Whitmore *op. cit.* 11; Markgraf *op. cit.* 23; Anderson *op. cit.* 148; Ashton *op. cit.* 23; Corner *op. cit.* 152; Whitmore, Tantra & Sutisna *op. cit.* 25; Kessler & Sidiyasa *op. cit.* 52; PROSEA *op. cit.* (1994) 88, *op. cit.* (2001) 67; Turner *op. cit.* 123; Coode *et al.* (eds.) *op. cit.* 25; Argent *et al.* (eds.) *op. cit.* 81; Sidiyasa *op. cit.* 176; Middleton *op. cit.* 45; Beaman *et al. op. cit.* 103. **Basionym:** *Echites scholaris* L., Mant. (1767) 53. **Type:** *LINN. 302.2* (holotype LINN). (For further synonymy, *cf.* Sidiyasa *op. cit.* (1998) 176).

Medium-sized to large tree, 10–50(–60) m tall, 20–80(–130) cm diameter; *bole fluted at base and forming tall steep buttresses to 10 m high*, *to 4 m out*. **Bark** smooth, scaly and peeling off in rectangular flakes, mostly with large horizontal lenticels, pale brown; *inner bark* granular, creamy, yellow or straw-coloured, *with copious white latex*. **Leaves** in whorls of 4–8(–9), *with a distinct intrapetiolar stipule at the base of petiole*, *to 2.5 mm long*, subcoriaceous, glabrous, glossy and dark green above, glabrous or velutinous and glaucous below; blade obovate, elliptic or narrowly obovate, (5–)6–17(–31) × (1.5–)2.5–8.5 cm, base acute or decurrent into the petiole, sometimes obtuse, apex obtuse or rounded, sometimes retuse; midrib sunken above; *lateral veins 25–45*(*–55*) *pairs*, *closely spaced and almost perpendicular to the midrib*; intercostal venation reticulate; petiole 5–25 mm long, flattened and shallowly canaliculate above, slightly winged. **Inflorescences** 4–13(–17) long, compound, many-flowered, mostly forming two bunches of many and densely clastered flowers. **Flowers** fragrant; pedicels 0–2 mm long, pubescent; calyx pubescent outside; *corolla pubescent or partly pubescent outside*, white, yellow or cream, 7–12 mm long in mature bud, *lobes overlapping to the left in bud*, ovate to broadly ovate, or suborbicular, 3–5 × 2.5–4.5(–7) mm, spreading in open flower; ovary ovoid or broadly ovoid, 0.9–1.5 × 0.7–1 mm, tomentose; disk obscure or absent. **Fruits** glabrous, 20–40(–63) cm long, *c.* 2(–2.5) mm diameter. **Seeds** oblong, 4.5–5.5(–7) × 1.2–1.6(–2) mm, glabrous on both sides, *ends rounded*; coma 8–14 mm long.

Vernacular names. Sabah—*pulai* (Malay). Sarawak—*kacau gitik* (Malay), *pulai lilin* (preferred name).

Distribution. India, Myanmar, Thailand, Laos, Vietnam, Malesia, Australia, Solomon, and Vanuatu. In Borneo, scattered in Sabah (*SAN 27410*, *SAN 51713*, *SAN 94109*, *SAN 95355*, and *SAN 122167*), Sarawak (e.g., *S 19640*, *S 54284* and *S 57432*), Brunei (e.g., *BRUN 5407*), and Kalimantan (e.g., *Ambriansyah & Arifin AA959*, *Sidiyasa 1103* and *Kostermans 6772*).

Ecology. Primary and secondary forests, along streams (rarely in swamps), coastal plains, ridges, on clay or ultrabasic soils, granite bedrock and limestone, at altitudes to 1230 m.

Uses. As a treatment for diarrhoea, stomach ache and snakebite. For snakebites the latex is applied at the edge of the wound.

7. **Alstonia spatulata** Blume

(Latin, *spatulatus* = spatula-shaped; the leaf)

Bijdr. Fl. Ned. Ind. (1826) 1037; King & Gamble *op. cit.* 437; Merrill *op. cit.* 498; Ridley *op. cit.* 346; Masamune *op. cit.* 617; Monachino *op. cit.* 153; Browne *op. cit.* 63; Smythies *op. cit.* 20; Whitmore *op. cit.* 12; Markgraf *op. cit.* 25; Anderson *op. cit.* 148; Ashton *op. cit.* 26; Corner *op. cit.* 152; Whitmore, Tantra & Sutisna *op. cit.* 25; PROSEA *op. cit.* (1994) 89, *op. cit.* (2001) 68; Turner *op. cit.* 123; Coode *et al.* (eds.) *op. cit.* 25; Argent *et al.* (eds.) *op. cit.* 81; Sidiyasa *op. cit.* 181; Middleton *op. cit.* 46. **Type:** *Blume s.n.* (= *RHL Sheet No. 898129143*), Java (holotype L). **Synonym:** *Alstonia cuneata* Wall. *ex* G.Don *op. cit.* 87.

Medium-sized tree, 10–25 m tall, 15–40 cm diameter; *bole sometimes forming plank symmetrical buttresses to 1.2 m high*. **Bark** smooth, scaly or minutely fissured and peeling off in square or rectangular flakes, pale to dark grey or almost black; *inner bark* white, creamy or pale yellow, *with copious white latex*. **Leaves** in whorls of 3–5, *without a distinct intrapetiolar stipule at the base of petiole*, coriaceous, glabrous on both sides, glossy and dark green above, pale green below, yellowish grey when dry; *blade spatulate*, *sometimes obovate*, 3–12 × 1.8–4.8 cm, base obtuse, acute, or decurrent into the petiole, *apex rounded*, sometimes retuse; midrib sunken above; *lateral veins closely spaced and almost perpendicular to the midrib*, 20–40 pairs; intercostal venation inconspicuous; *petiole 4–15 mm long*, flattened and shallowly canaliculate above, *slightly winged*. **Inflorescences** 3–11 cm long, *with a few* (*3–6*), *loose flowers*. **Flowers** fragrant; pedicels (2.5–)4–9 mm long, glabrous; *calyx glabrous on both sides*, ciliate; *corolla glabrous outside*, white, yellow or cream, 14–15 mm long in mature bud, *lobes overlapping to the left in bud*, elliptic, 6.7–11 × 3.5–6 mm, margins most often undulate, not ciliate, spreading or almost reflexed in open flower; ovary ovoid to broadly ovoid, 0.8–1.5 × 0.9–1.5 mm; disk absent. **Fruits** *glabrous*, 12–25 cm long, 2.5–3 mm diameter, smooth or almost so. **Seeds** oblong, 5–6 × 1.6–2.2 mm, *ends rounded or sometimes obtuse*, glabrous on both sides; coma (12–)15–22 mm long.

Vernacular names. Sabah—*pulai basong* (preferred name). Sarawak—*pulai apong* (Malay), *pulai pipit* (Malay).

Distribution. Cambodia, Thailand, Vietnam, Sumatra, Peninsular Malaysia, Singapore, Java, Borneo, and New Guinea. In Borneo, scattered in Sabah (e.g., *SAN 84745*, *SAN 102989*, *SAN 115213*, *SAN 126124*, and *SAN 126179*), Sarawak (e.g., *S 12441*, *S 16701*, *S 26696*, *S 29377*, and *S 30156*), Brunei (e.g., *BRUN 5711*), and Kalimantan (e.g., *bb. 18115* and *bb. 12625*).

Ecology. Swampy areas, mostly in secondary vegetations, on sandy soils, at altitudes to 600 m.

2. **CERBERA** L.

(Greek, *cerberos* = the dog guarding the gates of hell in Greek mythology;
inference unknown but may be due to the prescence of scales over the stamens
at the red corolla throat in *C. manghas*)

Sp. Pl. (1753) 208; King & Gamble, J. As. Soc. Beng 74, 2 (1907) 426; Ridley, FMP 2 (1923) 338; Backer & Bakhuizen *f.*, FJ 2 (1965) 232; Whitmore, TFM 2 (1973) 12; Anderson, CLTS (1980) 148; Ashton, MNDTS 2 (1988) 26; Corner, WSTM 3rd. edition 1 (1988) 153; Kessler & Sidiyasa, TBSA-EK (1994) 53; Coode *et al.* (eds.), CLBD (1996) 26; Argent *et al.* (eds.), MNDT-CK 1 (1997) 81; PROSEA 5, 3 (1998) 154, PROSEA 12, 2 (2001) 151; Middleton, Fl. Thailand 7 (1999) 65; Leeuwenberg, Agric. Univ. Wag. Pap. 98-3 (1999) 5.

Shrubs or small trees, *most frequently growing near sea or along rivers* (also often cultivated). **Sapwood** grey and soft. **Twigs** (*young*) *less than 1 cm diameter*. **Leaves** *spirally arranged*, with axillary glands; *blade obovate or elliptic*, *more than 2 cm wide*. **Inflorescences** paniculate, terminal; bracts foliolose, very similar to the sepals. **Flowers:** sepals generally quite large, without colleters inside; *corolla tube narrow*, *lobes overlapping to the left in bud*, mature corolla salver-shaped, sometimes weakly funnel-shaped at top of tube, lobes elliptic to obovate, corona of short lobes perpendicular to the corolla tube above and below stamens; *stamens completely included in corolla tube*, more or less sessile, *anthers connate to each other by their non-bristly appendages at the top*, ovate, fertile except for the appendage; disk absent; ovary of 2 separate carpels united into a common style, glabrous, with several ovules per carpel, style filiform. **Fruit** a drupe, with one seed per locule, often only one carpel developing; exocarp fleshy; *mesocarp fibrous*; *endocarp lignified*. **Seeds** flattened, ellipsoid.

Notes. Care has to be exercised when referring to the literature on *Cerbera* species as the names *C. manghas* and *C. odollam* have frequently been used incorrectly.

Key to *Cerbera* species

Stamens inserted at apex of corolla tube leading to a bulge right at corolla throat; corolla mostly white with a red “eye”; principally sea-shore trees…………..…**1. Cerbera manghas**

Stamens inserted around the middle of corolla tube leading to a bulge in the middle of the tube; corolla mostly white with a yellow “eye”; principally riverine trees……………………
…………………………………………………………………..…**2. Cerbera odollam**

1. **Cerbera manghas** L.

(from the word mango; referring to the mango-like fruit)

Sp. Pl. (1753) 208; Merrill, EB (1921) 500; Masamune, EPB (1942) 619; Browne, FTSB (1955) 66; Backer & Bakhuizen *f. op. cit.* 233; Whitmore *op. cit.* 12; Anderson *op. cit.* 148; Ashton *op. cit.* 27; Corner *op. cit.* 153; Coode *et al.* (eds.) *op. cit.* 26; PROSEA *op. cit.* (1998) 156, *op. cit.* (2001) 154; Middleton *op. cit.* 67; Leeuwenberg *op. cit.* 21. **Type:** *Osbeck s.n.*, “East India” (LINN 298.2). **Synonyms:** *Tanghinia manghas* (L.) G.Don *op. cit.* (1837) 98; *Cerbera lactaria auct. non* Buch.-Ham. *ex* Spreng: Ridley *op. cit.* 339. (For further synonymy, *cf.* Leeuwenberg *op. cit.* 21).

Tree to 25 m tall, generally much smaller, to 70 cm diameter, generally much less. **Bark** grey or reddish brown, smooth or flaky; inner bark white or khaki. **Sapwood** white. **Twigs** glabrous. **Leaves** papery to coriaceous, brittle when dry; blade elliptic to obovate, 5–31 × 1–7 cm, 1.7–7 times as long as wide, base decurrent onto the petiole, apex acute, acuminate or apiculate, rarely rounded; lateral veins 13–40 pairs; intercostal venation reticulate to obscure; petiole 0.9–4.5 cm long. **Inflorescence** few- to many-flowered, robust, lax although more congested at top, 5–31 cm long, glabrous. **Flowers:** pedicels 0.3–2.8 cm long; sepals narrowly elliptic to oblanceolate, 8–21 × 2–9 mm, erect or somewhat spreading, apex acute or acuminate, glabrous; *corolla mostly white with a red* "*eye*", reported also as pure white, tube 1.7–4.3 cm long, *widening near top and not bulging around the middle*, lobes obliquely elliptic, 1.5–2.9 × 9–18 mm, 1.1–2.1 times as long as wide, glabrous outside, pubescent for most of the length of tube inside; *stamens inserted just beneath the mouth of corolla tube*, anthers 1.3–3 × 1.1–2 mm; ovary 1.2–2 mm long, style and pistil head 2.1–4 mm long. **Fruits** ripening red, oblong to ellipsoid, 5–12 × 3–7 cm.

Vernacular names. Sabah—*pong-pong* (preferred name). Sarawak—*entiba* (preferred name).

Distribution. From Seychelles through eastern Asia and Malesia to the Pacific Is. and northern Australia. In Borneo, common in Sabah (e.g., *SAN 41590*, *SAN 86166*, *SAN 86781*, and *SAN 103222*), Sarawak (e.g., *S 24318* and *S 41959*) and Kalimantan (e.g., *Ambriansyah & Arifin 177*).

Ecology. On beaches above the high tide mark or in forest near sea.

Uses. In traditional medicine, the fruits are said to alleviate rheumatism and the latex to counteract sting-ray poison. The wood is soft and of little use except for making charcoal.

2. **Cerbera odollam** Gaertn. Fig. 3, Plate 1C.

(from the name *odallam* in Rheede's Hortus Malabaricus)

Fruct. Sem. Pl. 2 (1791) 193; King & Gamble *op. cit.* 427, *p.p.*; Ridley *op. cit.* 339; Backer & Bakhuizen *f. op. cit.* 233; Whitmore *op. cit.* 12; Anderson *op. cit.* 148; Ashton *op. cit.* 28; Corner *op. cit.* 153; PROSEA *op. cit.* (1998) 156, *op. cit.* (2001) 154; Middleton *op. cit.* 67. **Type:** *Odallam Rheede*, *Hort. Malab. 1* (*1678*) *t. 39*. **Synonyms:** *Cerbera lactaria* Buch.-Ham. *ex* Spreng., Syst. 1 (1825) 642; *C. dilatata* Markgr. *in* Engler, Bot. Jahrb. 61 (1927) 196.

Tree to 24 m tall, although generally much smaller, to 40 cm diameter, generally much less. **Bark** white or grey; inner bark white or pale brownish. **Sapwood** white. **Leaves** papery to coriaceous, brittle when dry; blade obovate, 8.9–26 × 2–5.7 cm, 2.5–5 times as long as wide, base decurrent onto the petiole, apex acute, acuminate or apiculate; lateral veins 12–25 pairs; intercostal venation reticulate to obscure; petiole 1.6–4 cm long. **Inflorescences** few- to many-flowered, robust, lax although more congested at top, 8.8–35 cm long, glabrous. **Flowers:** pedicels 0.5–4 cm long; sepals narrowly elliptic to oblanceolate, 6–26 × 2.5–5 mm, erect or somewhat spreading, apex acute or acuminate, glabrous; *corolla mostly white with a yellow* "*eye*", reported also as pure white, *tube* 13–25 mm long, *bulging around the middle*, lobes obliquely elliptic, 12–38 × 8–15 mm, 1.4–3 times as long as wide, glabrous outside, pubescent in upper half of tube inside; *stamens inserted at 6.5–15 mm from the base of corolla tube*, anthers 2–4 × 1.2–2 mm; ovary 1.2–2 mm long, style and pistil head 8–12 mm long. **Fruits** ripening red, subglobose to ellipsoid, 4.7–11 × 3.7–11 cm.

Distribution. From Sri Lanka to New Caledonia. In Borneo, scattered in Sabah (e.g., *SAN 77677*, *SAN 79630*, *SAN 80643*, *SAN 126139*, and *SAN 127068*), Sarawak (e.g., *Clemens 21214*, *S 18153*, *S 18575*, *S 33601*, and *S 40189*), Brunei (e.g., *BRUN 5174*, *BRUN 16175*, *BRUN 15946*, *BRUN 5069*, and *BRUN 3104*), and Kalimantan (e.g., *Winkler 3433*).

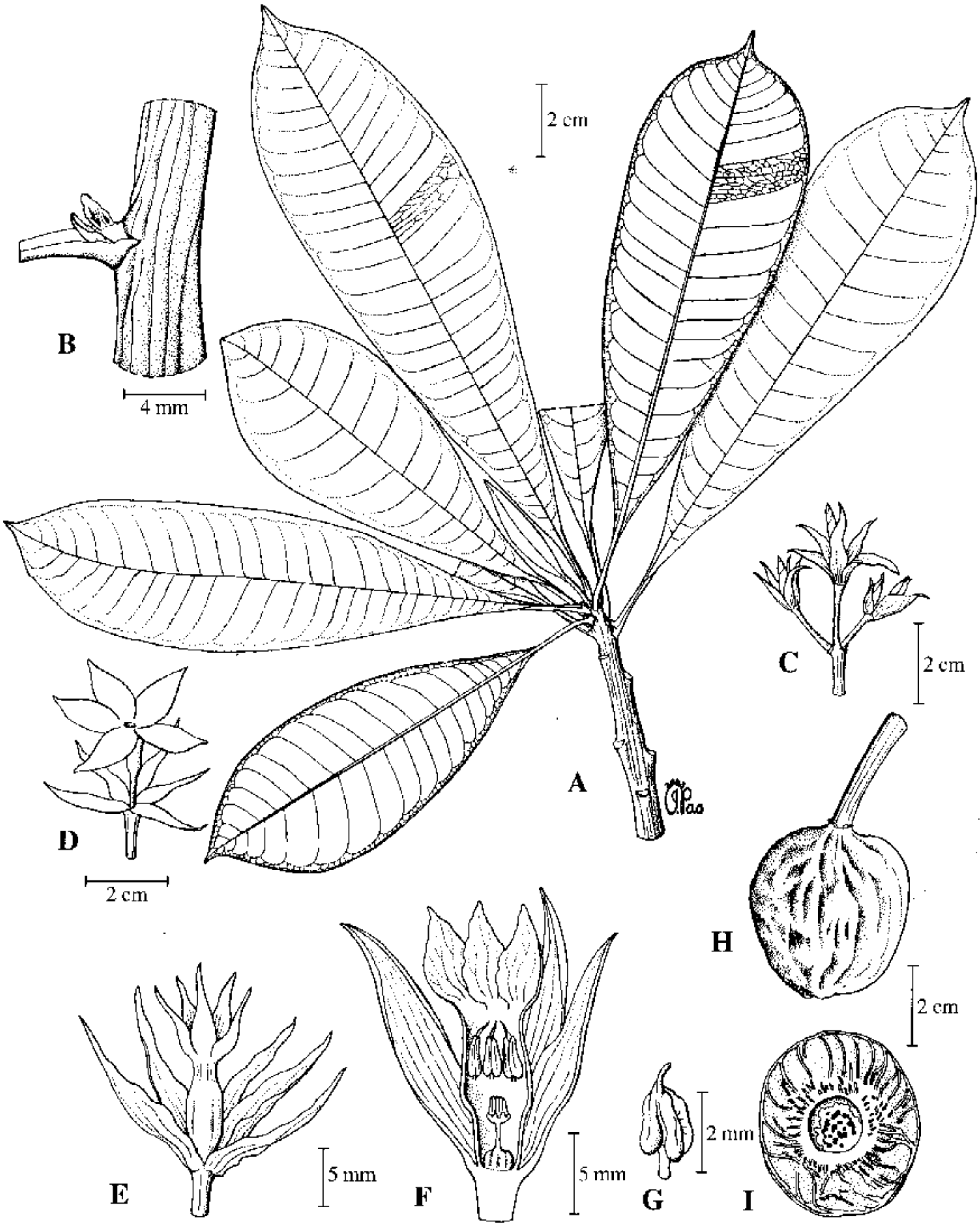

Fig. 3. *Cerbera odollam*. A, leafy twig; B, intrapetiolar stipule-like flap; C, part of inflorescence; D, fully open flower; E, partially open flower; F, longitudinal section of partially open flower; G, stamen; H, fruit; I, cross-section of fruit. (A–B and H from *SAN 80643*, C from *Clemens 21214*, D–G from *S 18575*, I from *FA 8*.)

Ecology. In, or on the edge of, mangrove and riverine forests.

Uses. Very commonly planted as a roadside tree and in gardens. Also used medicinally in a bath after childbirth.

3. **DYERA** Hook.*f.*

(W. Thiselton Dyer, 1843–1928, an English botanist)

jelutong (preferred name)

J. Linn. Soc. 19 (1882) 293; King & Gamble, J. As. Soc. Beng. 74, 2 (1907) 442; Ridley, FMP 2 (1923) 344; Monachino, Lloydia 9 (1946) 174; Backer & Bakhuizen *f.*, FJ 2 (1965) 227; Smythies, CST (1965) 20; Whitmore, TFM 2 (1973) 13; Cockburn, TS 1 (1976) 18; Anderson, CLTS (1980) 148; Ashton, MNDTS 2 (1988) 28; Corner, WSTM 3rd. edition 1 (1988) 154; Whitmore, Tantra & Sutisna, CLK 1 (1990) 25; Kessler & Sidiyasa, TBSA-EK (1994) 53; PROSEA 5, 2 (1995) 225, PROSEA 18 (2000) 65; Coode *et al.* (eds.), CLBD (1996) 26; Argent *et al.* (eds.), MNDT-CK 1 (1997) 81; Middleton, Fl. Thailand 7 (1999) 36.

Trees, *often growing to enormous size*; *trunk columnar*; *buttresses absent*; *white latex present in all plant parts*. **Twigs** *usually strongly longitudinally ribbed when young*, occasionally weakly so. *Intrapetiolar stipules more than 3 mm long*. **Leaves** *whorled*; *blade often weakly crenulate at margin*, glabrous; petioles relatively long. **Inflorescences** of umbelliform or paniculate cymes, lax or somewhat congested in upper parts. **Flowers:** sepals with colleters inside, connate at base, lobes often of different sizes; *corolla* lobes overlapping to the left in bud, *mature corolla platter-shaped*, *tube much shorter than the lobes*, lobes oblong to lanceolate, more or less symmetrical, auriculate at the base on both sides, glabrous on both sides; stamens free from the pistil head, completely included in the corolla tube, filaments short and narrow, *anthers* lanceolate, base cordate, *apex apiculate without long appendage*, dehiscing laterally; disc annular, inconspicuous, adnate to the ovary; ovary apocarpous but carpels closely associated and appearing syncarpous, pubescent, with many ovules per carpel, style and pistil head short. **Fruits** of paired, *divergent heavy and woody follicles*, dehiscing at maturity. **Seeds** *elliptic*, *flattened*, *with a broadly membranous wing.*

Distribution. Two species, distributed in S Thailand, Sumatra, Peninsular Malaysia, and Borneo.

Ecology. In evergreen and swamp forests at relatively low altitudes.

Uses. Formerly the latex of both species was an important ingredient for chewing gum. This led to overtapping, especially of *Dyera polyphylla*. This use has greatly diminished. The light and soft timber of *jelutong* is excellent for hand-carving and for making or manufacturing a variety of products requiring light, soft and light-colour (whitish) wood, *e.g.*, pattern in foundry work, pencils, picture frames, wooden toys, clogs, ceilings, partitioning, matchsticks, match boxes, packing cases, etc. (For more details see PROSEA *op. cit.* (1995) 225, *op. cit.* (2000) 65).

Note. The two species are very closely related and not always easy to distinguish.

Key to *Dyera* species

Tree without pneumatophore roots; leaf apex mostly obtuse to shortly acuminate, rarely rounded; leaf base subcordate to rounded, rarely cuneate, not decurrent onto petiole………..
…………………………………………………………………………………**1. D. costulata**

Tree with pneumatophore roots; leaf apex emarginate, rarely rounded or apiculate; leaf base cuneate and decurrent onto petiole…………………………………………..…**2. D. polyphylla**

1. **Dyera costulata** (Miq.) Hook.*f.* Fig. 4, Plate 1D.

(Latin, *costulatus* = ribbed; possibly in reference to the ribbed twigs)

J. Linn. Soc. 19 (1882) 293; King & Gamble *op. cit.* 443; Merrill, EB (1921) 498; Ridley *op. cit.* (1923) 345; Masamune, EPB (1942) 619; Monachino *op. cit.* 190; Browne, FTSB (1955) 60; Backer & Bakhuizen *f. op. cit.* 227; Smythies *op. cit.* 21; Whitmore *op. cit.* 13; Cockburn *op. cit.* 19; Anderson *op. cit.* 148; Ashton *op. cit.* 32; Corner *op. cit.* 154; Whitmore, Tantra & Sutisna *op. cit.* 25; Kessler & Sidiyasa *op. cit.* 53; Turner, Gard. Bull. Sing. 47 (1995) 126; PROSEA *op. cit.* (1995) 229, *op. cit.* (2000) 65; Coode *et al.* (eds.) *op. cit.* 26; Argent *et al.* (eds.) *op. cit.* 83; Middleton *op. cit.* 36. **Basionym:** *Alstonia costulata* Miq., Fl. Ind. Bat. Suppl. (1861) 556. **Lectotype** (designated here)**:** *Diepenhorst HB 1114*, Sumatra, Priaman (hololectotype U; isolectotypes K, L). **Synonyms:** *Alstonia grandifolia* Miq., *op. cit.* 555; *A. eximia* Miq., *op. cit.* 555; *Dyera laxiflora* Hook.*f.*, Fl. Brit. Ind. 3 (1882) 644, King & Gamble *op. cit.* 444, Ridley *op. cit.* 345.

Tree to 80 m tall, to 300 cm diameter, sometimes with somewhat exposed roots *but without knee-shaped pneumatophores*. **Bark** dark grey, brown or black, peeling off evenly in small, squarish flakes bearing a dappled, somewhat rough appearance on the lower part; inner bark cream, pale grey or pale reddish. **Sapwood** cream or white. **Twigs** 3.5–9 mm diameter, glabrous. **Stipules** 3–6 mm long. **Leaves** in whorls of 4–8, coriaceous to papery, glabrous on both surfaces; blade obovate, oblong or elliptic, 5.5–42 × 1.8–14 cm, 1.6–4.3 times as long as wide, *base subcordate to rounded*, *rarely cuneate*, *not decurrent onto petiole*, margin crenulate or weakly crenulate, *apex obtuse*, *short-acuminate or rarely rounded*; midrib sunken to slightly raised above; lateral veins 12–24 pairs, forming 45–80° angle with the midrib, clearly distinguishable from the intercostal venation, prominent or flat above, prominent below; intercostal venation reticulate or subscalariform, prominent on both sides; petiole 2–6.2 cm long, glabrous. **Inflorescences** arranged in whorls, 4–18 cm long, glabrous, many-flowered; peduncles 2.5–9.2 cm long. **Flowers:** pedicels 1.5–6.5 mm long; sepals ovate or orbicular, 1–3 × 0.8–2 mm, 1–1.5 times as long as wide, apex rounded to acute, ciliate or not, glabrous; corolla white, yellowish green or pinkish yellow, tube 1.1–3 mm long, glabrous on both sides, lobes 3–9 × 1.2–2.3 mm, 1.7–4.4 times as long as wide, glabrous on both sides; stamens inserted at 0.5–0.6 mm from the base of corolla tube, anthers 1.1–1.4 × 0.4–0.5 mm, 2.7–3 times as long as wide, exserted 0–0.8 mm from corolla throat; ovary 0.3–0.6 mm long, style 0–0.2 mm long; pistil head 0.5–0.7 mm long. **Fruits** 18–40 × 2.5–4 cm. **Seed** grains *c*. 2.5 × 1.5 cm, including wings *c*. 5 × 2 cm.

Vernacular name. Sabah and Sarawak—*jelutong bukit* (preferred name).

Distribution. S Thailand, Sumatra, Peninsular Malaysia, and Borneo. In Borneo, common in Sabah (e.g., *SAN 28098*, *SAN 36768*, *SAN 49557*, *SAN 55688*, and *SAN 84691*), Sarawak (e.g., *S 3565*, *S 28738*, *S 37551*, *S 65627*, and *S 68565*), Brunei (e.g., *BRUN 3152*, *Wong*

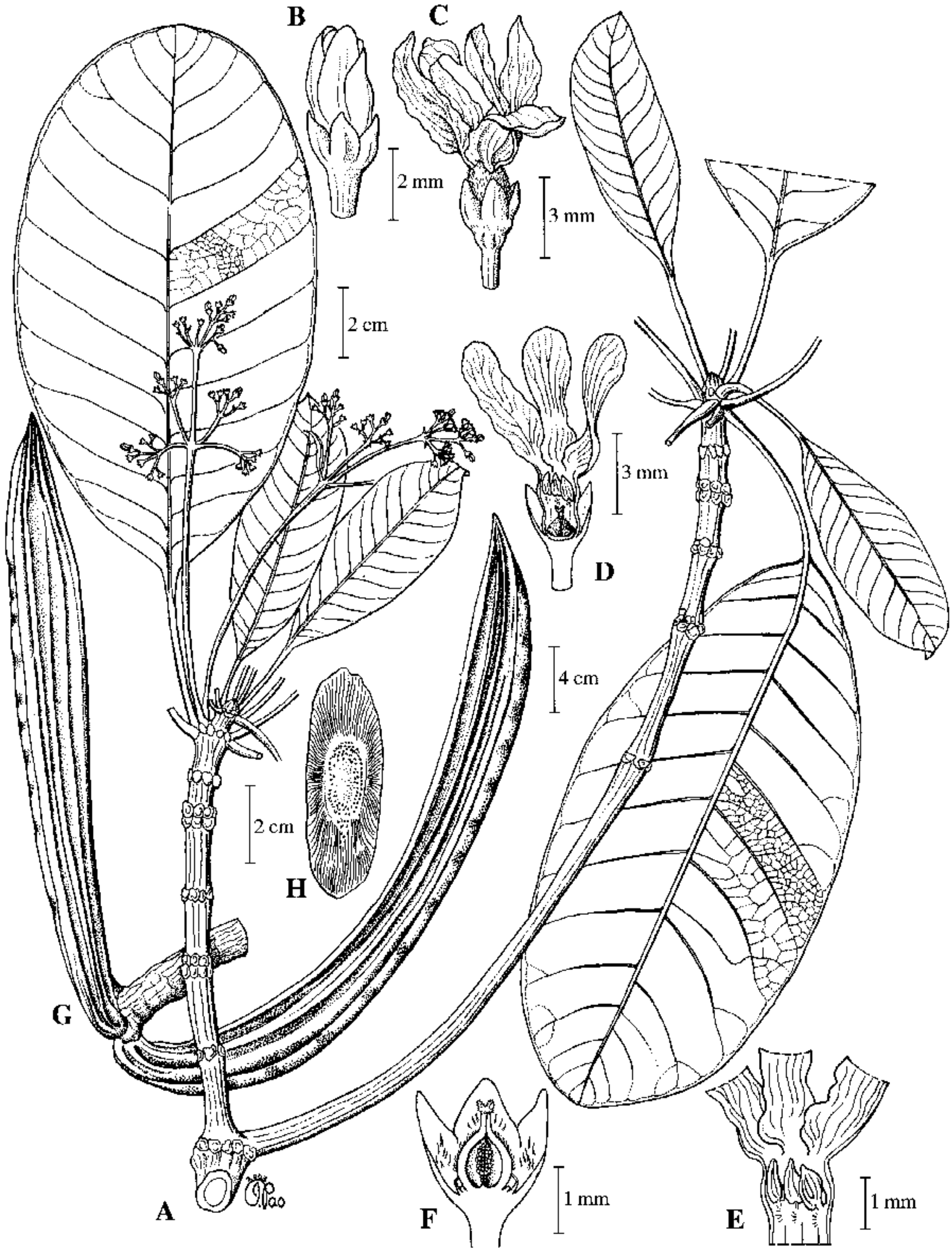

Fig. 4. *Dyera costulata*. A, flowering leafy twig; B, flower bud; C, open flower; D, longitudinal section of open flower; E, stamens showing attachment to corolla tube; F, longitudinal section of gynoecium; G, fruit; H, seed. (A from *S 37571*, B–F from *FMS 7999*, G–H from *KLU 1355*.)

WKM 252, *Ashton 1107*, and *Tan 87*), and Kalimantan (e.g., *bb. 16255*, *bb. 16962* and *bb. 18246*).

Ecology. In both open areas and forest where it can be a large emergent tree, at altitudes to 1220 m.

2. **Dyera polyphylla** (Miq.) Steenis

(Greek, *poly-* = many, *phullon* = leaf; with many leaves)

Blumea 14 (1967) 316; Cockburn *op. cit.* 20; Anderson *op. cit.* 148; Ashton *op. cit.* 32; Whitmore, Tantra & Sutisna *op. cit.* 25; PROSEA *op. cit.* (1995) 230, *op. cit.* (2000) 65; Argent *et al.* (eds.) *op. cit.* 83. **Basionym:** *Alstonia polyphylla* Miq. *op. cit.* 556. **Lectotype** (designated here)**:** *Teijsmann HB 3212*, Sumatra, Bangka, Jebus (hololectotype U; isolectotype L). **Synonyms:** *Dyera lowii* Hook.*f.*, *op. cit.* 293, Merrill *op. cit.* 498, Masamune *op. cit.* 619, Monachino *op. cit.* 194, Browne *op. cit.* 63, Smythies *op. cit.* 21, Coode *et al.* (eds.) *op. cit.* 26; *D. borneensis* Baill., Bull. Soc. Linn. Paris, 1 (1888) 751, Merrill *op. cit.* 498, Masamune *op. cit.* 619.

Tree to 60 m tall, to 200 cm diameter; *knee-shaped pneumatophore roots chocolate brown*, *lenticellate*. **Bark** chocolate-brown or greyish brown with corky paler lenticels and horizontal ridges; inner bark cream. **Sapwood** cream. **Twigs** 11–14 mm diameter, glabrous. **Stipules** 4.5–5 mm long. **Leaves** in whorls of 6–8, coriaceous or subcoriaceous; blade obovate, 4–24 × 2.3–10.7 cm, 1.7–2.9 times as long as wide, *base cuneate*, *decurrent onto petiole*, margin not crenulate or only weakly so, *apex emarginate*, *retuse*, *or, more rarely, rounded*, *obtuse or apiculate*; midrib flat or slightly raised above; lateral veins 17–32 pairs, with 3–12 mm spacing, forming 65–75° angle with the midrib, more or less straight to curved-ascending, slightly prominent or flat above, not prominent below; intercostal venation reticulate to somewhat scalariform, not prominent on both sides; petiole 2.1–4.5 cm long. **Inflorescences** arranged in whorls, 8.5–14 cm long, glabrous; peduncles 4–11 cm long. **Flowers:** pedicels 1.5–3 mm long; sepals ovate to orbicular, 1–1.4 × 1–1.4 mm, 0.9–1.2 times as long as wide, apex rounded or obtuse, not ciliate, glabrous; corolla tube 1–3 mm long, glabrous or slightly pubescent below stamens inside, glabrous outside, lobes 1.8–4 × 1–1.7 mm, 1.4–3 times as long as wide, glabrous on both sides, not ciliate; stamens inserted at 0.5–0.6 mm from the base of corolla tube, filaments *c.* 0.3 mm long, anthers 0.8–1.5 × 0.3–0.4 mm, 2.7–3.8 times as long as wide, exserted 0.1–0.8 mm from corolla throat; ovary 0.5–0.9 mm long, style 0–0.1 mm long; pistil head *c.* 0.5 mm long. **Fruits** 22–30 × 1.8–4 cm. **Seed** grains 1.8–2 × 0.8–1.2 mm, including wings 3.7–4.5 × 1.2–1.5 mm.

Vernacular name. Sabah and Sarawak—*jelutong paya* (preferred name).

Distribution. Sumatra and Borneo. In Borneo, locally common in Sabah (e.g., *SAN 22297*, *SAN 36671* and *SAN 130247*), Sarawak (e.g., *Haviland 2170*, *KEP 10816*, *KEP 79326*, *S 9750*, and *S 58063*), Brunei (e.g., *BRUN 16911*, *FMS 30549*, *Van Niel 3966*, *Watson 39633*, and *Kamaruddin KMS 2406*), and Kalimantan (e.g., *bb. 18112*, *bb. 28079*, *bb. 29444*, *bb. 35355*, and *bb. 19973*).

Ecology. Peat swamp forest at low altitude, frequently in association with *Alstonia pneumatophora*.

4. **KIBATALIA** G.Don

(from a Sundanese name—*ki batali*)

Gen. Syst. 4 (1837) 86; Backer & Bakhuizen *f.*, FJ 2 (1965) 238; Whitmore, TFM 2 (1973) 16; Anderson, CLTS (1980) 149; Rudjiman, Agric. Univ. Wag. Pap. 86-5 (1986) 36; Ashton, MNDTS 2 (1988) 33; Whitmore, Tantra & Sutisna, CLK 1 (1990) 25; PROSEA 5, 3 (1998) 313, PROSEA 12, 2 (2001) 322; Middleton, Fl. Thailand 7 (1999) 90; Beaman *et al.*, PMK 4 (2001) 107. **Synonyms:** *Hasseltia* Blume, Bijdr. Fl. Ned. Ind. 15 (1826) 1045; *Kickxia auct. non* Dumortier: Blume, Rumphia 4 (1848) 25.

Trees or large shrubs with white latex in all parts. **Twigs** sparsely lenticellate, often transversely fissured. **Leaves** *opposite*, *without a flap inside the base of petiole*, *uppermost pair not concealing apical bud*; *blade coriaceous*; midrib prominent below; *domatia present in the axils of lateral veins with the midrib or absent*. **Inflorescences** *with a very short peduncle*; *flowers laxly fascicled*. **Flowers** often distinctly 5-angled; *sepals free except at the very base*, ovate, with colleters inside; *corolla lobes overlapping to the right in bud*, mature corolla salver-shaped; stamens sessile or subsessile, *anthers* narrowly triangular, apex acute or acuminate, base sagittate, with sterile area, *adnate to the pistil head*, exserted from or included in the corolla tube; *disk not as high as ovary*, *5-lobed*, *glabrous*; ovary of two separate carpels united into a common style, ovules numerous, style filiform; pistil head conical or ovoid. **Fruits** *of paired follicles*, narrowly ellipsoid or cylindrical, lenticellate or not. **Seeds** *consisting of seed grain and a long basal beak with coma*; *hairs of coma directed towards apex of follicle*.

Distribution. About 15 species, distributed in SE Asia and Malesia. Two species in Sabah; 4 species in Sarawak.

Key to *Kibatalia* species

1. Lateral veins to 7 pairs; corolla tube mostly less than 10 mm long……...**3. K. maingayi**
Lateral veins 8 pairs or more; corolla tube mostly more than 10 mm long…………..…2

2. Intercostal venation obscure; blade 3–6.1 times as long as wide; corolla lobes more than 3.5 times as long as wide…………………………………………..…**2. K. borneensis**
Intercostal venation clearly visible; blade 1.7–3.8 times as long as wide; corolla lobes less than 3.5 times as long as wide……………………………………………………3

3. Domatia absent on leaves below; stamens included………………………**1. K. arborea**
Domatia present on leaves below; stamens exserted……………………..…**4. K. villosa**

1. **Kibatalia arborea** (Blume) G.Don

(Latin, *arboreus* = tree-like; the growth habit)

Gen. Syst. 4 (1837) 86; Blume *op. cit.* (1848) 26; Woodson, Philip. J. Sci. 60 (1936) 226; Backer & Bakhuizen *f. op. cit.* 238; Anderson *op. cit.* 149; Rudjiman *op. cit.* 43; PROSEA *op. cit.* (1998) 313, *op. cit.* (2001) 323; Middleton *op. cit.* (1999) 91; Beaman *et al. op. cit.* 107. **Basionym:** *Hasseltia arborea* Blume *op. cit.* (1826) 1046. **Lectotype** (Rudjiman, 1986)**:** *Blume s.n.* (= *RHL Sheet No.*

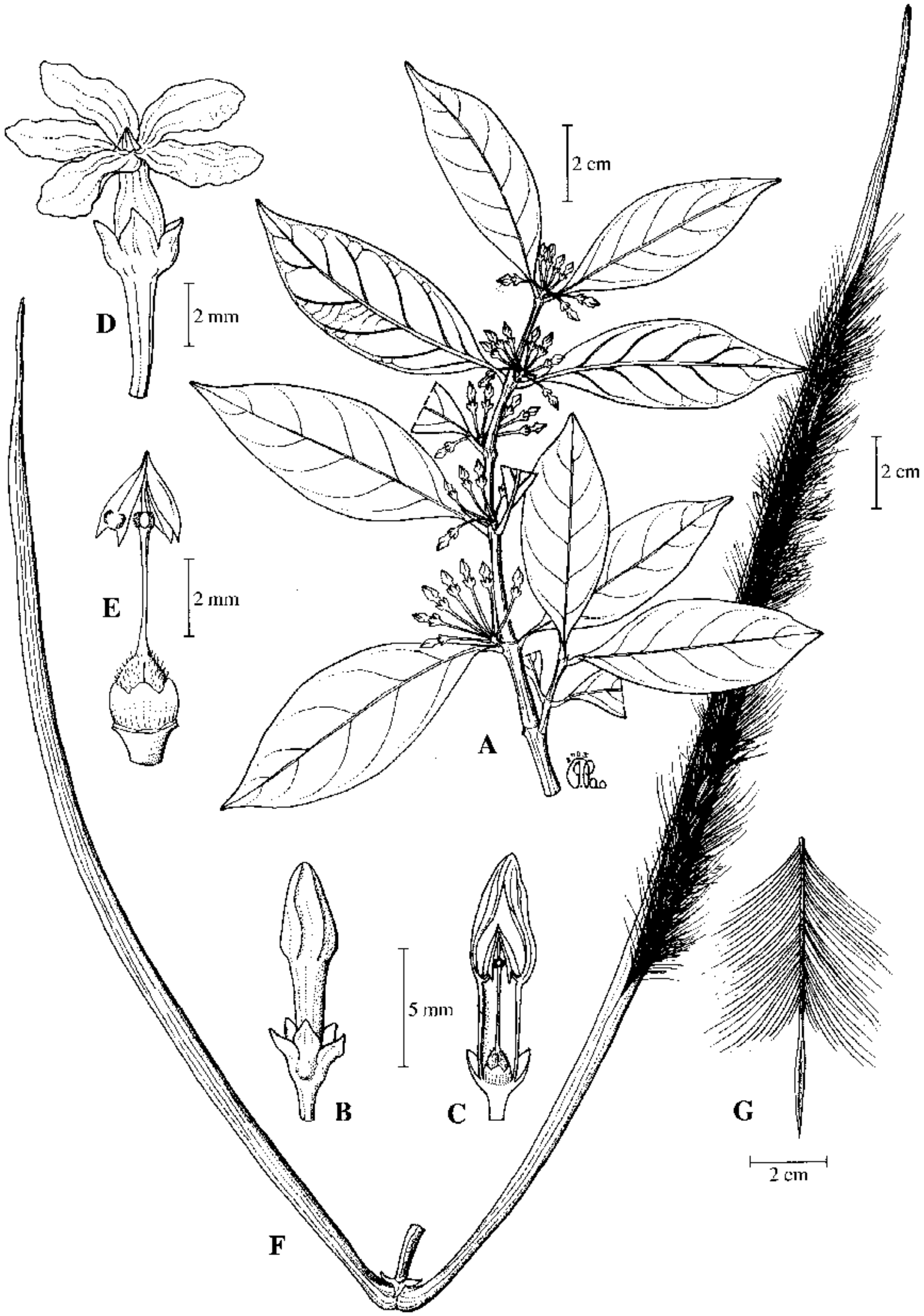

Fig. 5. *Kibatalia maingayi*. A, flowering leafy twig; B, flower bud; C, longitudinal section of flower bud; D, open flower; E, pistil showing anther attachment; F, fruit with one of the two follicles dehiscing; G, seed. (A–E from *S 15637*, F–G from *FA 1306*.)

25250255), Java, Bogor, Cihampea (hololectotype L; isolectotypes M, W). **Synonym:** *Kickxia arborea* (Blume) Blume, Fl. Jav. Ins. (1828) 7.

Tree to 45(–65) m tall, to 100 cm diameter; bole straight with short buttresses. **Bark** grey, grey-brown, dark brown or black; inner bark white, light orange or greenish. **Sapwood** white or pale yellow. **Leaves** coriaceous or papery; blade elliptic, less often obovate, 9.7–26(–35) × 3.5–13 cm, *1.7–2.5 times as long as wide*, base rounded to cuneate, apex acute, acuminate or obtuse; *domatia absent*; *lateral veins 11–18 pairs*; *intercostal venation clearly visible*; petiole 5–14(–30) mm long. **Inflorescences** lax, 8–10 cm long, 1–2-flowered; peduncles 2–5 mm long. **Flowers:** pedicels 3–5 mm long; sepals 4–7 × 2–3 mm, obtuse, acute to acuminate at apex, glabrous outside; corolla white or creamy, *tube 24–45 mm long*, lower part 10–15 mm long, upper part 12–25(–40) mm long, glabrous, *lobes 2.3–3.2 times as long as wide*, elliptic or narrowly obovate, 30–40 × 10–18 mm, glabrous or pubescent on both sides; *stamens included*, inserted at 7–19 mm from the base of corolla tube, anthers 6–7 × 1–2 mm; disk cup-shaped, 2–3 mm high, obscurely 5-lobed; ovary 2.5–4 mm high, glabrous, style 1–1.9 cm long; pistil head 1–3 mm long. **Fruits** pendulous, 25–85 × 1–2.5 cm. **Seed** grains 28–35 × 2–3.5 mm, beak glabrous for *c.* 5 cm with an apical coma for 3–8 cm; coma hairs 2–10 cm long.

Distribution. Thailand, Sumatra, Peninsular Malaysia, Borneo, Java, Sulawesi, and the Philippines (Palawan Is.). In Borneo, scattered in Sabah (e.g., *SAN 17287*, *SAN 25131*, *SAN 30296*, *SAN 107853*, and *SAN 133833*), rare in Sarawak (e.g., *Richards 1307*).

Ecology. Lowland forest at altitudes to 500 m.

Uses. Used with great care as a tonic against internal parasites in Java.

2. **Kibatalia borneensis** (Stapf) Merr.

(of Borneo)

Philip. J. Sci. 17 (1920) 309; Anderson *op. cit.* 149; Rudjiman *op. cit.* 50; Ashton *op. cit.* 33; Whitmore, Tantra & Sutisna *op. cit.* 26. **Basionym:** *Kickxia borneensis* Stapf. *in* Hooker, Icon. Pl. ser. 4, 27 (1901) *t.* 2693, Merrill, EB (1921) 501. **Type:** *Lobb s.n.*, Sarawak (holotype K). **Synonym:** *Kibatalia villosa* Rudjiman *op. cit.* 82, *p.p.* (excluding the type).

Shrub or small tree to 5 m tall. **Bark** dark brown. **Leaves** coriaceous; *blade* elliptic, oblong or slightly obovate, 9–20 × 2.4–6 cm, *3–6.1 times as long as wide*, base cuneate, apex acuminate to caudate; domatia present, rarely absent; *lateral veins 8–11*(*–15*) *pairs*; *intercostal venation mostly obscure*; petiole 5–20 mm long. **Inflorescences** lax, 5–8 cm long, 1–2-flowered, glabrous; peduncles *c.* 2 mm long. **Flowers:** pedicels *c.* 5 mm long; sepals narrowly ovate, 4–7.5 × 2–2.5 mm, 2–3.8 times as long as wide, apex acuminate; corolla white, *tube* (*20–*)*30–37 mm long*, lower part (11–)15–18 mm long, upper part (8–)15–20 mm long, glabrous outside, pubescent inside, *lobes 3.7–4.2 times as long as wide*, narrowly elliptic, (15–)30–36 × (5–)8–9 mm, glabrous on both sides or with few hairs at base inside; stamens included, inserted at 19–22 mm from the base of corolla tube, anthers 5–5.5 × 1–1.5 mm; disk ring-shaped, *c.* 0.5 mm high, obscurely 5-lobed; ovary 2–4 mm high, glabrous, style *c.* 18 mm long; pistil head 1–2 mm long. **Fruits** very narrowly cylindical, 10–30 × 0.4–0.6 cm. **Seeds** with a coma all over; grains 18–20 × 2–3 mm, beak 3–11 mm long; coma hairs 15–30 mm long.

Vernacular name. Sarawak—*pulai ucong* (preferred name).

Distribution. Endemic in Borneo. Known only from Sarawak (e.g., *S 12251*, *S 12954*, *S 13052*, *S 24323*, and *S 27076*).

Ecology. Swamp or *kerangas* forest at low altitude.

3. **Kibatalia maingayi** (Hook.*f.*) Woodson Fig. 5.

(A.C. Maingay, 1836–1869, British physician and botanist, sometime jail-warden in Malacca, Peninsular Malaysia)

Philip. J. Sci. 60 (1936) 213; Whitmore *op. cit.* 18; Anderson *op. cit.* 149; Ashton *op. cit.* 36; Rudjiman *op. cit.* 69; Whitmore, Tantra & Sutisna *op. cit.* 26; PROSEA *op. cit.* (1998) 315; Middleton *op. cit.* 92. **Basionym:** *Vallaris maingayi* Hook.*f.*, Fl. Brit. Ind. 3 (1882) 651, King & Gamble, J. As. Soc. Beng. 74, 2 (1907) 461, Ridley, FMP 2 (1923) 351. **Lectotype** (Rudjiman, 1986)**:** *Maingay 2948* (= *Kew Distr. 1084*), Peninsular Malaysia, Malacca (hololectotype K; isolectotypes K, L). **Synonyms:** *Paravallaris maingayi* (Hook.*f.*) Kerr, Fl. Siam. En. 2 (1939) 456; *Holarrhena daronensis* Elmer, Leafl. Philip. Bot. 4 (1912) 1455; *Vallaris daronensis* (Elmer) Merr., Philip. J. Sci., Bot. 10 (1915) 70; *Kibatalia daronensis* (Elmer) Woodson *op. cit.* 218.

Tree to 40 m tall, to 120 cm diameter, sometimes with buttresses. **Bark** smooth or rough, pale brown, dark grey or whitish; inner bark pale yellow, less often brown. **Leaves** coriaceous, glabrous; blade narrowly to broadly elliptic, 3.5–14 × (1–)2–6 cm, 2.1–4.75 times as long as wide, base cuneate or decurrent onto petiole, apex acuminate or subcaudate; domatia absent or present, if present, with or without hairs; *lateral veins 4–7 pairs*; intercostal venation obscure; petiole 2–10 mm long. **Inflorescences** congested, 1.5–2.5 cm long, 4–25-flowered; peduncles 1–3 mm long. **Flowers:** pedicels 7–12(–15) mm long; sepals acute or acuminate at apex, 1.5–3 × 1–2 mm, glabrous or, rarely, pubescent; *corolla* white or pale yellow, *tube 5–8(–10) mm long*, lobes obovate or ovate, rarely elliptic, 6–12 × 3–7 mm, 1.4–2.3 times as long as wide, sparsely to densely pubescent on both sides; stamens exserted, inserted at 5–8(–10) mm from the base of corolla tube, anthers 2–2.5(–3) × 0.75–1 mm; disk ring- to cup-shaped, 0.5–1.5 mm high, 5-lobed; ovary 1–2 mm high, style 4.5–6.5(–9) mm long; pistil head to 1 mm long. **Fruits** very narrowly cylindrical, 8–50 × 0.4–0.6 cm. **Seed** grains 20–35 × 1.5–3 mm, beak glabrous for 5–10 mm, bearing an apical coma for 0–65 mm; coma hairs 10–80 mm long.

Distribution. Thailand, Sumatra, Peninsular Malaysia, Borneo, and the Philippines (Mindanao). In Borneo, very local in Semengoh FR, Sarawak (e.g., *Carroll 1185*, *S 12725*, *S 13953*, *S 15637*, and *S 37185*) and in Kalimantan (e.g., *Kostermans 6698*, *Kostermans 10051*, *Kostermans 10689*, and *Rudjiman 242*).

Ecology. In lowland and lower montane forests.

4. **Kibatalia villosa** Rudjiman

(Latin, *villosus* = villous; referring to the densely hairy corolla mouth)

Agric. Univ. Wag. Pap. 86-5 (1986) 82, *p.p.* (excluding some of the paratypes); PROSEA *op. cit.* (1998) 315. **Type:** *Rudjiman 266*, Borneo, S Kalimantan, Kuala Barito, Bambangin (holotype BO; isotypes BO, L, WAG).

Tree to 30 m tall, to 70 cm diameter. **Bark** smooth; inner bark brown. **Sapwood** pale yellow. **Leaves** coriaceous, glabrous; *blade* elliptic to slightly obovate, 8–18 × 3.6–7.5 cm, *1.2–3.1 times as long as wide*, base cuneate, apex acute to acuminate, less often obtuse or caudate; *domatia consisting of pits*; *lateral veins 8–12 pairs*; *intercostal venation clearly visible below*, *perpendicular to midrib and oblique to lateral veins*; petiole 5–15 mm long. **Inflorescences** congested, 8–25-flowered, 2.5–2.75 cm long; peduncles 1–5 mm long. **Flowers:** pedicels 10–12 mm long, glabrous or sparsely puberulent near base; sepals acute at apex, 1.75–4.5 × 1.5–2 mm, glabrous or sparsely puberulent; corolla white or yellowish green, *tube* (*9–*)*11–14 mm long*, *lobes 0.9–2 times as long as wide*, narrowly elliptic or elliptic, 7–9 × 4.5–7.5(–10) mm, outside glabrous, inside glabrous at base, pubescent at top of tube and inside of lobes; *stamens exserted*, inserted at 10–12 mm from the base of corolla tube, anthers 3 × 1–1.5 mm; disk ring- to cup-shaped, 1–2 mm high; ovary 2–3 mm high, style 8–11 mm long; pistil head 1.5–2 mm long. **Fruits** narrowly spindle-shaped, 18.5–22.5 × 0.8–0.9 cm.

Distribution. Peninsular Malaysia and Borneo. In Borneo, uncommon in Sabah (e.g., *SAN 61372* and *SAN 118479*), Sarawak (e.g., *Haviland 3050*, *S 12954* and *S 23014*), Brunei (e.g., *Davies & Othman A 1369*), and Kalimantan (e.g., *bb. 18491* and *Kostermans 5585*).

Ecology. Swamp to lower or montane forests, often on limestone, at altitudes to 1200 m.

5. **KOPSIA** Blume, *nom. cons.*

(J. Kops, 1765–1849, a Dutch botanist)

Cat. (1823) 12; King & Gamble, J. As. Soc. Beng. 74, 2 (1907) 429; Ridley, FMP 2 (1923) 336; Sleesen, Fl. Mal. Misc. Rec. 1 (1959) 1; Backer & Bakhuizen *f.*, FJ 2 (1965) 232; Markgraf, Blumea 20 (1972) 416; Whitmore, TFM 2 (1973) 18; Anderson, CLTS (1980) 149; Ashton, MNDTS 2 (1988) 36; Corner, WSTM 3rd. edition 1 (1988) 155; Sévenet *et al.*, J. Ethnopharm. 41 (1994) 147; Coode *et al.* (eds.), CLBD (1996) 27; Middleton, Fl. Thailand 7 (1999) 60; Beaman *et al.*, PMK 4 (2001) 108.

Shrubs or small trees. **Leaves** *opposite*, *uppermost pair more or less concealing terminal bud*, *without domatia below*, *with a large interpetiolar ridge and glands in the axils*; *blade coriaceous*. **Inflorescences** *cymose*, *sometimes raceme-like or cinninate-like in appearance due to aborting flowers*; bracts persistent. **Flowers:** *sepals free except at base*, without colleters inside; *corolla lobes overlapping to the right in bud*, mature corolla salver-shaped, white or pink, sometimes with a coloured "eye", lobes oblong or obovate, acute to rounded; *stamens free from the pistil head*, completely included in the corolla tube, filaments short and narrow, anthers narrowly ovate, base cordate, apex acute, fertile for the entire length; *disk of 2 narrow lobes*; ovary of 2 separate carpels united into a common style, glabrous or pubescent, 2 ovules per carpel, style filiform with a collared style head. **Fruits** *drupes*, *solitary or paired*, *often with an appendage on one side*, *this sometimes hooked*. **Seeds** *simple*, ovoid, flattened.

Distribution. About 22 species in E Asia, through Malesia to the W Pacific and N Queensland. Six species in Sabah and Sarawak.

Key to *Kopsia* species

1. Inflorescence delicate with clear internodes; corolla tube less than 20 mm long………..
…………………………………………………………………………….…**5. K. tenuis**
Inflorescence not delicate, with or without clear internodes; corolla tube more than 20 mm long, if less than 20 mm then inflorescence congested…………………………..…2

2. Leaves elliptic or oblong with lateral veins forming 40−60° angle with the midrib; inflorescence with a robust peduncle and long branches with closely spaced flowers, only one open at a time……………………………………………..…**4. K. rajangensis**
Leaves variable with lateral veins forming (55−)60−80° angle with the midrib; inflorescence variable but if lateral veins angle is less than 60° then inflorescence short and congested…………………………………………………………………………3

3. Sepals mostly acute, more rarely obtuse; fruit without an appendage…….**1. K. arborea**
Sepals rounded to obtuse at apex; fruit with an appendage on one side……………...…4

4. Inflorescence axes mostly robust, pedicels 2.8−5.2 mm long; lateral veins 23−43 pairs...

K. sleeseniana Markgr.

(E.H.L. Timmerman-van der Sleesen, a Dutch botanist)

Blumea 20 (1972) 421; Sévenet *et al. op. cit.* 161. Type: *Haviland 3046*, Borneo, Sarawak, Bintulu district (holotype SING; isotypes K, L, SAR). Synonym: *Kopsia* sp., Sleesen *op. cit.* (1959) 15, Ashton *op. cit.* 39.

Shrub to 2 m tall. Twigs glabrous, not lenticellate, terete or weakly angled. Leaves papery to subcoriaceous, glabrous; blade elliptic or oblong, 8.5–21.5 × 3.6–7.8 cm, 2.2–5 times as long as wide, base rounded to cuneate, apex caudate or long acuminate with a blunt tip; midrib shallowly sunken or raised and with a central groove above; *lateral veins 23–43 pairs*, *forming c. 70° angle with the midrib*, with 2–9 mm spacing, prominent on both sides, intramarginal vein straight or only weakly looped, distant from or right at margin; petiole 7–12 mm long, glabrous. Inflorescences dichasial, higher order branching is not opposite but alternate, *6–10.2 cm long with axes 2.2–7.5 cm long*, glabrous; peduncles 0.6–4.5 cm long, 1.4–2.2 mm diameter, glabrous. Flowers: pedicels 2.8–5.2 mm long, glabrous; bracteoles absent; *sepals* ovate, 1.3–1.6 × 1–1.6 mm, 1–1.3 times as long as wide, *apex rounded or obtuse*, ciliate, glabrous on both sides; corolla completely white, *tube 26.5–32 mm long*, 1.9–2.6 mm wide, 1.6–2.1 times as long as lobes, 18.7–20.4 times as long as calyx, lobes narrowly elliptic or oblong, 13.2–20 × 3.3–6 mm, 3.3–4 times as long as wide, apex obtuse, not ciliate, glabrous on both sides; stamens inserted at *c.* 22 mm from the base of corolla tube, anthers *c.* 2.4 × 0.8 mm, *c.* 3 times as long as wide, *c.* 1.1 mm from corolla throat; disk awl-shaped, *c.* 0.8 mm long, apex acuminate, glabrous, *c.* 0.7 times as long as ovary; ovary *c.* 1.2 mm high, densely pubescent on top, style *c.* 19.4 mm long; pistil head *c.* 0.9 mm long. *Fruits flattened oblique ellipsoid with a blunt hooked spur*, 16–17 × 7 × 4 mm, densely puberulent.

Only known from Sarawak, around Bintulu and in Similajau NP (e.g., *Haviland 3046*, *S 40133*, *S 65629*, and *S 65651*). Lowland mixed dipterocarp and beach forests at altitudes to 80 m.

Inflorescence axes mostly not robust; pedicels 1.2–2.5 mm long; lateral veins 9–24 pairs……………………………………………………………………………...…5

5. Inflorescences more than 10 cm long, densely puberulent……………..…**2. K. dasyrachis**
Inflorescences less than 10 cm long, glabrous to densely puberulent…..**3. K. pauciflora**

1. **Kopsia arborea** Blume

(Latin, *arboreus* = tree-like; the growth habit)

Cat. (1823) 13; Sleesen *op. cit.* (1959) 9; Backer & Bakhuizen *f. op. cit.* 232; Markgraf *op. cit.* 419; Ashton *op. cit.* 37; Sévenet *et al. op. cit.* 149; Middleton *op. cit.* (1999) 61; Beaman *et al. op. cit.* 108. **Type:** *Blume s.n.* (= *RHL Sheet No. 898110313*), Java, Mt. Salak (holotype L). **Synonyms:** *Kopsia longiflora* Merr., Philip. Gov. Lab. Bur. Bull. 29 (1905) 47; *K. scortechinii* King & Gamble *op. cit.* 431, Ridley *op. cit.* (1923) 337, Whitmore *op. cit.* 20, Turner, Gard. Bull. Sing. 47 (1995) 127; *K. laxinervia* Merr., Philip. J. Sci. Bot. 13 (1918) 55; *K. lancibracteolata* Merr., Philip. J. Sci. 23 (1923) 262. (For further synonymy, *cf.* Middleton *op. cit.* (1999) 61).

Tree to 14 m tall, to 10 cm diameter. **Bark** grey; inner bark pale brown. **Twigs** glabrous or sparsely puberulent when young, sparsely lenticellate or not. **Leaves** subcoriaceous to coriaceous, glabrous; blade elliptic, 4.5–30.5 × 1.4–12 cm, 1.9–5.7 times as long as wide, base acute or cuneate, apex caudate to acuminate with a blunt tip; midrib sunken or raised and with a central groove above; *lateral veins forming 60–65° angle with the midrib*, 9–18 pairs, with 4–13 mm spacing, prominent on both sides; intramarginal vein strongly looped; petiole 3–10 mm long, glabrous. **Inflorescences** *dichasial*, 4.8–15.3 cm long, glabrous to sparsely puberulent; peduncles 0.7–8.1 cm long, glabrous or puberulent in upper parts. **Flowers:** pedicels 0–5 mm long, glabrous to densely puberulent; *sepals* ovate, lanceolate or oblong, 1.8–6.3 × 0.6–1.9 mm, 1–3.7 times as long as wide, *apex acute*, *more rarely obtuse*, ciliate, glabrous to sparsely puberulent outside; corolla completely white, *tube 20.5–35 mm long*, 1.6–2.2 mm wide, lobes elliptic or oblong, apex rounded to obtuse, 7–21.5 × 3.4–6.5 mm, 1.6–4.4 times as long as wide, inside glabrous or sparsely pubescent in upper quarter, outside glabrous; stamens inserted at 18–32.3 mm from the base of corolla tube, anthers 1.2–1.7 × 0.5–0.8 mm, 2–3.4 times as long as wide, 0.1–1.4 mm from corolla throat; disk oblong, hourglass-shaped, or awl-shaped, apex shape variable and often quite complex ranging from simply acuminate to rounded to horizontally V-shaped and flat on top or horizontally V-shaped and retuse on top, 0.7–2.1 mm long, glabrous, 1.1–1.9 times as long as ovary; ovary 0.9–1.2 mm high, glabrous to sparsely pubescent all over, style 18–25 mm long; pistil head 0.8–1.1 mm long. **Fruits** *without a hooked appendage*, oblique ellipsoid or subglobose, 14–42.4 × 5.5–15.5 × 8–22 mm, glabrous, blue-black.

Distribution. India (Andaman Is.), Myanmar and S China through Indo-China and Malesia to N Queensland. In Borneo, scattered in Sabah (e.g., *Andau 848*, *Bakia 235*, *Lugas 1409*, *SAN 126903*, and *SAN 131248*), Sarawak (e.g., *S 16033* and *S 40186*) and Kalimantan (e.g., *Kostermans 7673* and *Laman et al. TL 594*).

Ecology. In a wide variety of forest types and soil types at altitudes to 1500 m.

2. **Kopsia dasyrachis** Ridl.

(Greek, *dasy-* = thickly hairy, *rachis* = rachis; the hairy peduncle)

Bull. Misc. Inform. Kew (1934) 123; Masamune, EPB (1942) 620; Sleesen *op. cit.* (1959) 8; Markgraf *op. cit.* 424; Sévenet *et al. op. cit.* 151. **Type:** *Arsat 1211*, Borneo, Sabah, Lukan (holotype K).

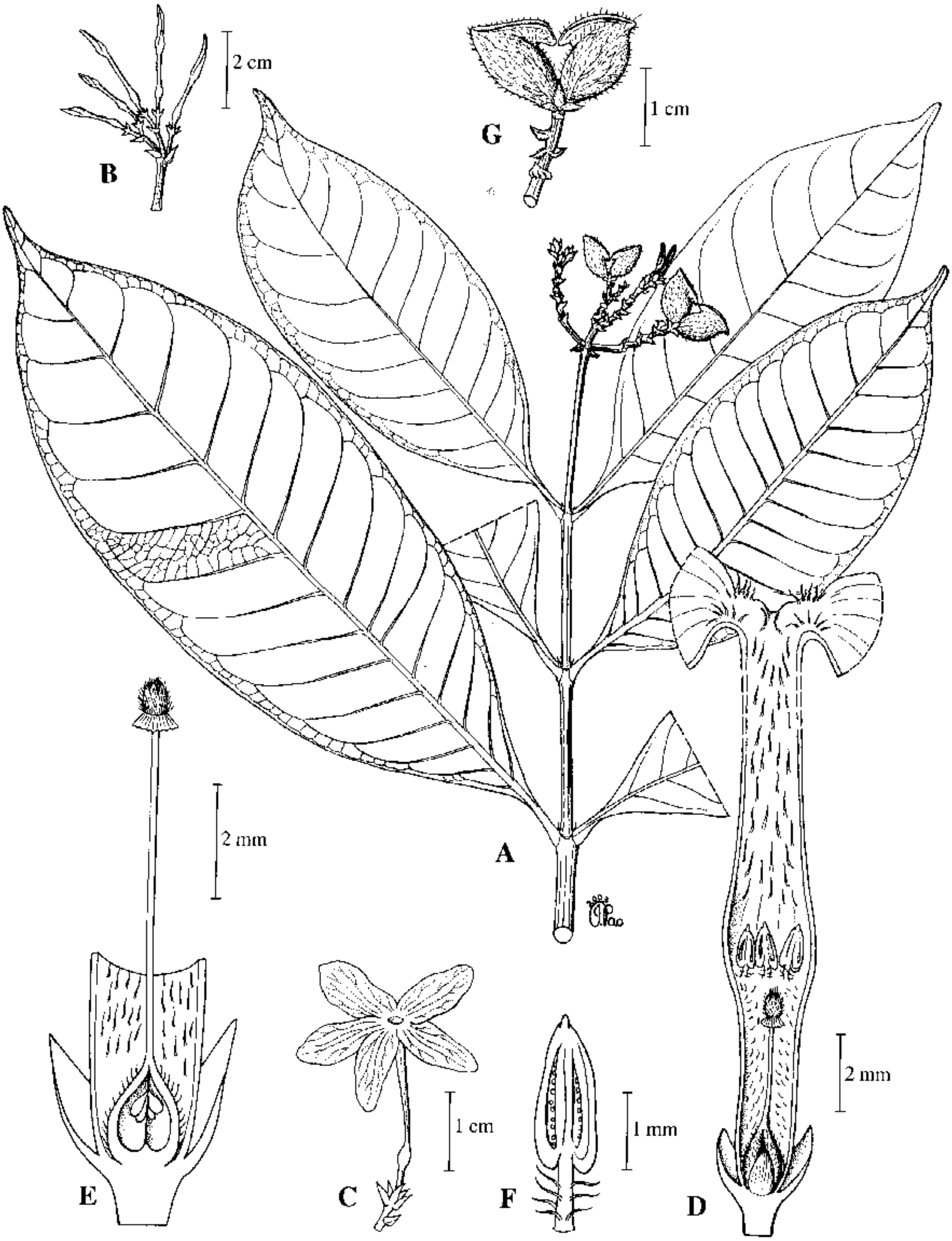

Fig. 6. *Kopsia pauciflora* var. *mitrephora*. A, fruiting leafy twig; B, part of inflorescence; C, open flower; D, longitudinal section of open flower; E, longitudinal section of flower showing gynoecium; F, stamen; G, dehiscing fruit. (A and G from *SAN 4065*, B–F from *SAN 89338*.)

Tree to 10 m tall, to 15 cm diameter. **Bark** grey or yellow, smooth; inner bark white. **Twigs** glabrous, sparsely lenticellate, weakly winged. **Leaves** subcoriaceous to coriaceous, glabrous; blade elliptic, 6.5–24.5 × 2–10.2 cm, 2.1–3.3 times as long as wide, base acute to cuneate, apex long-acuminate with a blunt tip; midrib shallowly sunken or raised and with a central groove above; *lateral veins 9–16 pairs*, *with 6–18 mm spacing*, *forming 65–70° angle with the midrib*, prominent to sunken above, prominent below; intramarginal vein straight, weakly or strongly looped, inset from margin; petiole 5–7 mm long, glabrous. **Inflorescences** terminal with dichasial branching followed by cincinnate branches and then compact dichasial inflorescence ends, *10.7–15.2 cm long with axes 3.7–16 cm long*, *densely puberulent*; peduncles 2.7–9.3 cm long, 1.9–2.3 mm diameter, puberulent. **Flowers:** *pedicels c. 1.2 mm long*, densely puberulent; *sepals* oblong, 2.3–3.7 × 1.4–2.2 mm, 1.6–1.75 times as long as wide, *apex rounded to obtuse*, ciliate, densely puberulent outside; corolla completely white, *tube 22–35 mm long*, *c.* 1.4 mm wide, lobes elliptic, apex rounded, 16–28 × 6.2–7 mm, 2.6–4 times as long as wide, ciliate only at lobe base, glabrous on both sides; stamens inserted at 19–21 mm from the base of corolla tube, anthers 1.9–2.6 × 0.5–0.6 mm wide, 3.8–4.6 times as long as wide, 5.2–5.8 mm from corolla throat; disk awl-shaped, narrowly deltoid or lanceolate, apex acuminate, 1.1–1.5 mm long, glabrous, 0.9–1.7 times as long as ovary; ovary 0.9–1.5 mm high, densely pubescent on top or densely pubescent all over, style 17–20 mm long; pistil head 1.1–1.4 mm long. **Fruits** 12–17 × 5.4–6 × 7–10 mm, sparsely puberulent; *spur blunt*, *hooked*, *3.5–6 mm long.*

Distribution. Endemic in Borneo and currently only known from Sabah (e.g., *SAN 22491*, *SAN 22492*, *SAN 23377*, *SAN 60023*, and *SAN 67340*), where it is locally fairly common.

Ecology. Mostly in lowland mixed dipterocarp forest, generally on well drained soils, at altitudes to 900 m.

3. **Kopsia pauciflora** Hook.*f.* Fig. 6, Plate 1E.

(Latin, *pauci-* = few, *florus* = flower; with few-flowered inflorescence)

Fl. Brit. Ind. 3 (1882) 639; Ridley *op. cit.* (1923) 337; Sleesen *op. cit.* (1959) 14; Whitmore *op. cit.* 19; Markgraf *op. cit.* 422; Ashton *op. cit.* 38; Sévenet *et al.*, *op. cit.* 160; Turner *op. cit.* 127. **Type:** *Maingay Kew Distr. 1056*, Peninsular Malaysia, Johore, Mt. Ophir (holotype K; isotype L). **Synonyms:** *Kopsia parvifolia* Merr., Philip. J. Sci. 29 (1926) 412, Sleesen *op. cit.* (1959) 8, Sévenet *et al. op. cit.* 160, Beaman *et al. op. cit.* 108; *K. caudata* Merr., PEB (1929) 254, Sévenet *et al. op. cit.* 150, Coode *et al.* (eds.) *op. cit.* 27; *K. caudata* Merr. var. *glabra* Merr. *op. cit.* (1929) 255, Sévenet *et al.*, *op. cit.* 151; *K. alba* Ridl. *ex* Henderson, Gard. Bull. S. S. 5 (1930) 78, Sévenet *et al.*, *op. cit.* 149, Turner *op. cit.* 127; *K. lancifolia* Markgr., *op. cit.* 425, Sévenet *et al.*, *op. cit.* 156.

Tree to 10 m tall, to 15 cm diameter. **Bark** grey, olive-brown or white, smooth; inner bark pale brown, straw-coloured or white. **Twigs** glabrous or sparsely puberulent, not lenticellate to densely lenticellate, weakly angled to markedly winged. **Leaves** subcoriaceous to coriaceous, glabrous or, rarely, puberulent on midrib on both sides, rarely also puberulent on major veins below; blade elliptic or oblong, 5–24 × 1.1–7.5 cm, 1.8–6.1 times as long as wide, base rounded to cuneate, apex caudate to shortly acuminate with a blunt tip; midrib shallowly to deeply sunken to raised and with a central groove above; *lateral veins 9–24 pairs*, *with 2–14 mm spacing*, *forming* (*55–*)*65–80° angle with the midrib*, prominent or flat above, prominent below; intramarginal vein straight to weakly or strongly looped, sometimes obscure; petiole 0–9 mm long, glabrous. **Inflorescences** *dichasial or cincinnate*, *3.5–7 cm long with axes 0.5–5 cm long*, *glabrous to densely puberulent*; peduncles 0–1.8

cm long, 0.8–2 mm diameter, glabrous or puberulent. **Flowers:** *pedicels 0.5–2.5 mm long*, glabrous to densely puberulent; *sepals* ovate or oblong, 1.5–2.9 × 1–2.5 mm, 0.8–2 times as long as wide, *apex rounded*, ciliate or not, glabrous to densely puberulent on upper half inside; corolla completely white, white with a yellow eye, or white and green, *tube 15–44 × 1.1–2.8 mm*, lobes elliptic, 9–33 × 3.5–19 mm, 1.7–4.1 times as long as wide, apex rounded or obtuse, ciliate or not, glabrous on both sides; stamens inserted at 3.5–33 mm from the base of corolla tube, anthers 1.7–2.8 × 0.4–0.8 mm, 2.6–5.6 times as long as wide, 2.4–19 mm from corolla throat; disk awl-shaped or deltoid, apex acute, acuminate, or irregularly toothed, 0.7–1.9 mm long, glabrous, 0.7–1.9 times as long as ovary; ovary 0.5–1.2 mm high, sparsely to densely pubescent, style 2.5–29.5 mm long; pistil head 0.5–1.3 mm long. **Fruits** *falcate with a small blunt hooked spur on one side*, sparsely puberulent, black when ripe, 12–18 × 2.5–6 × 6–9 mm; spur 3–5 mm long.

Distribution. S Thailand, Sumatra, Peninsular Malaysia, Borneo, and Java.

Ecology. In primary or secondary evergreen forest, on a variety of soils, often on limestone, at altitudes to 700 m.

Notes. In Sabah and Sarawak, two varieties (*viz*. var. *mitrephora* and var. *pauciflora*) are recognised.

Key to varieties

Corolla tube 25–44 mm long; stamens inserted at 22–33 mm from the base of corolla tube, anthers at 2.4–5 mm from corolla throat; style 20–29.5 mm long…………………………….

var. **pauciflora**

Tree to 10 m tall, to 15 cm diameter. Leaf blade elliptic; intramarginal vein usually straight or only weakly looped. Inflorescences dichasial or cincinnate. Flowers: *corolla tube 25–44 mm long*; *stamens inserted at 22–33 mm from the base of corolla tube*, *anthers at 2.4–5 mm from corolla throat*; *style 20–29.5 mm long*.

Distribution as the species. In Sabah common (e.g., *SAN 41227*, *SAN 49838*, *SAN 80114*, *SAN 120372*, and *SAN 129966*) but rare in Sarawak (e.g., *Native Collector 21*). Also occurring in Brunei (e.g., *BRUN 310*).

Corolla tube 25–28.5 mm long; stamens inserted at 3.5–15.5 mm from the base of corolla tube, anthers at 6.5–19 mm from corolla throat; style 2.5–12.5 mm long……..……………..

var. **mitrephora** (Sleesen) D.J.Middleton

(Greek, *mitra* = helmet, *phora* = bearing; referring to the fruit which is said to look like the helmets of ancient Greek soldiers)

Gard. Bull. Sing. 55 (2003) 66. Type: *Wood SAN 16118*, Borneo, Sabah, Lahad Datu district, path between Sg. Sabahan and Sg. Dok (holotype L; isotype BRI). Basionym: *Kopsia mitrephora* Sleesen, Blumea 10 (1960) 136, Markgr., *op. cit.* 424, Whitmore *op. cit.* 19, Sévenet *et al*., *op. cit.* 159.

Tree to 3 m tall. Leaf blade elliptic or oblong; intramarginal vein straight to strongly looped. Inflorescences dichasial. Flowers: *corolla tube 15–28.5 mm long*; *stamens inserted at 3.5–15.5 mm from the base of corolla tube*, *anthers at 6.5–19 mm from corolla throat*; *style 2.5–12.5 mm long*.

Only known from Sabah (e.g., *SAN 39373*, *SAN 51546*, *SAN 107254*, *SAN 124514*, and *SAN 141634*). In primary and secondary forests at altitude to 600 m.

4. **Kopsia rajangensis** D.J.Middleton

(of Rajang River, Sarawak)

Gard. Bull. Sing. 55 (2003) 65. **Type:** *Clemens & Clemens 21221*, Borneo, Sarawak, Kapit district, Upper Rajang R. (holotype MO; isotypes A, BM, BO, K, NY, SAR). **Synonyms:** *Kopsia larutensis auct. non* King & Gamble: Anderson *op. cit.* 149, Ashton *op. cit.* 38; *K. arborea auct. non* Blume: Markgraf *op. cit.* 419, *p.p.*

Shrub or small tree to 5 m tall. **Twigs** glabrous, not or sparsely lenticellate, terete. **Leaves** papery to subcoriaceous, glabrous; *blade elliptic or oblong*, 13.4–32 × 3.8–9.6 cm, 2.6–4.3 times as long as wide, base obtuse to cuneate, apex caudate; midrib shallowly sunken or raised and with a central groove above; *lateral veins forming 40–60° angle with the midrib*, 9–25 pairs, with 6–25 mm spacing, prominent or flat above, prominent below; intramarginal vein looped and inset from margin; petiole 4–9 mm long, glabrous. **Inflorescences** *dichasial and then with cincinnate branches*, *4–15 cm long with axes 1.4–20 cm long*, glabrous to densely puberulent; *peduncles robust*, 0.2–7.6 cm long, 1.7–3.7 mm diameter. **Flowers:** pedicels *c.* 4 mm long; sepals ovate, 1.5–1.7 × 1.1–1.4 mm, 1.2–1.4 times as long as wide, apex rounded, ciliate, otherwise glabrous on both sides; corolla white, *tube 21.5–26.5 mm long*, *c.* 2.3 mm wide, lobes elliptic or oblong, 11–15 × 2.7–4.7 mm, 3–4.5 times as long as wide, apex obtuse or acute, not ciliate, glabrous on both sides; stamens inserted at 17–21 mm from the base of corolla tube, anthers 1.7–2 × 0.6–0.8 mm, 2.5–2.8 times as long as wide, at 1.1–2 mm from corolla throat; disk awl-shaped, *c.* 0.9 mm high; ovary *c.* 0.9 mm high, glabrous to densely pubescent, style *c.* 20 mm long; pistil head *c.* 0.8 mm long. **Fruits** falcate with small blunt projection near the base, 15–16 × 4 × 6.5–7 mm; projection 3–4 mm long.

Distribution. Endemic in Borneo and apparently confined to the Rajang R. basin in Sarawak (e.g., *Clemens & Clemens 21211*, *Clemens & Clemens 21221*, *Haviland 3042*, *S 17797*, and *S 27738*).

Ecology. In hill primary and disturbed forests on rich clay soils.

5. **Kopsia tenuis** Leenh. & Steenis

(Latin, *tenuis* = slender; the delicate inflorescence)

Blumea 10 (1960) 138; Markgraf *op. cit.* 424; Sévenet *et al. op. cit.* 162. **Type:** *Ridley s.n.*, Borneo, Sarawak, Matang (holotype K).

Tree to 6 m tall, to 15 cm diameter. **Bark** brown, slightly flaky. **Twigs** glabrous, sparsely lenticellate or not, terete. **Leaves** papery, glabrous; blade elliptic, oblong or ovate, 3.2–13 × 1.2–3.3 cm, base acute to cuneate, apex caudate; lateral veins 16–28 pairs, with 1–3 mm spacing, forming 70–80° angle with the midrib; intramarginal vein right at margin; petiole 1–2 mm long, glabrous. **Inflorescences** *dichasial or flowers solitary*, *delicate*, *3.7–12.5 cm long with axes 1.1–15 cm long and 0.5–5 mm diameter*, sparsely puberulent; peduncles 0.2–2.2 cm long, 0.4–5 mm diameter, puberulent. **Flowers:** pedicels 4.5–5 mm long, glabrous or sparsely puberulent; sepals ovate, rounded, *c.* 1 × 0.9–1 mm, ciliate, glabrous; corolla completely white or yellowish, *tube 16–17 mm long*, *c.* 1.8 mm wide, pubescent around stamens and slightly below inside, throat glabrous outside, lobes narrowly elliptic or oblong, 11.5–15 × 2.4–3 mm, apex obtuse, not ciliate, glabrous on both sides; stamens inserted at *c.* 14 mm from the base of corolla tube, anthers *c.* 2 × 0.4 mm, *c.* 5 times as long as wide, at *c.*

2 mm from corolla throat; disk awl-shaped, *c.* 0.6 mm long, apex obtuse, glabrous, *c.* 0.7 times as long as ovary; *ovary c. 0.9 mm high*, *glabrous*, style *c.* 13 mm long; pistil head *c.* 0.9 mm long. **Fruits** flattened oblique ellipsoid with a blunt hooked spur, 12.5–15 × 5.6–7.3 × 3–3.4 mm; spur 3–4 mm long, arising in lower part of fruit, sparsely puberulent.

Distribution. Endemic in Borneo and so far only known from the western parts of Sarawak (e.g., *Clemens & Clemens 20129*, *Clemens & Clemens 20178*, *Clemens & Clemens 20898*, *S 34459*, and *S 43441*).

Ecology. In mixed dipterocarp forest at altitude *c.* 735 m on Mt. Pueh.

6. **OCHROSIA** Juss.

(Greek, *ochros* = ochre-yellow colour)

Gen. Pl. (1789) 144; Ridley, FMP 2 (1923) 339; Backer & Bakhuizen *f.*, FJ 2 (1965) 231; Markgraf, Blumea 25 (1979) 233; Anderson, CLTS (1980) 149; Ashton, MNDTS 2 (1988) 39; Corner, WSTM 3rd. edition 1 (1988) 156; Middleton, Fl. Thailand 7 (1999) 64; PROSEA 12, 2 (2001) 386; Hendrian, Blumea 49 (2004) 101. **Synonyms:** *Calpicarpum* G.Don, Gen. Syst. 4 (1837) 100; *Lactaria* Raf., Sylva Tell. (1838) 162; *Neisosperma* Raf., *op. cit.* 162; *Pseudochrosia* Blume, Ann. Mus. Bot. Lugd. Bat. 1 (1850) 158; *Bleekeria* Hassk., Retzia 1 (1855) 38; *Excavatia* Markgr., Bot. Jahrb. 61 (1927) 194.

Shrubs or trees with white latex. **Twigs** glabrous, not lenticellate. **Leaves** *in whorls of 3–6*, *more rarely opposite*, *without a small flap inside the base of petiole*; blade coriaceous to papery, glabrous, *margin entire*; midrib sunken above, prominent below; lateral veins usually rather straight, rarely strongly arcuate-ascending, usually joining and forming a submarginal vein, rarely not joining. **Inflorescences** *terminal and axillary cymes*, in whorls or solitary, loose or congested, few- to many-flowered, glabrous. **Flowers** sometimes fragrant, small, pedicellate; *sepals connate only at base*, without colleters inside; corolla salver-shaped, white, greenish white, creamy white, or yellowish white, pubescent inside, glabrous outside, *tube longer than lobes*, *lobes overlapping to the right in bud*; stamens included, free from each other, filaments filiform, short, *anthers without a long appendage*; *disk absent*; ovary of 2 carpels, glabrous, style filiform. **Fruits** *drupes*, usually apocarpous, rarely joined in lower half; *mericarps ellipsoid*, *obovoid*, *ovoid*, *or subglobose*, *sometimes somewhat dorso-ventrally compressed*, *sometimes with lateral and or apical ridges*; *endocarps splitting into diverging fibres*, *or consisting of thick and hard tissue surrounding 2 lateral cavities*. **Seeds** *simple*, 1–3 on each placenta, flat, suborbicular or elliptic, with a wing-like structure along the margin, glabrous.

Distribution. About 40 species, distributed from the Mascarene Is. and Seychelles in the west through continental S and SE Asia to Malesia and N Australia and into the Pacific Is. as far east as the Marquesas and Hawaiian Is. Three species in Sabah; one species in Sarawak.

Key to *Ochrosia* species

1. Twigs (4–)6–9 mm diameter; leaves mostly strongly obovate with a rounded or an apiculate apex; blades 1–3 times as long as wide; at least some lateral veins with spacing of more than 7 mm……………………………………..….**3. O. oppositifolia**
   Twigs 2–6 mm diameter; leaves elliptic to obovate, mostly with an acuminate apex; blades 2.1–5.8 times as long as wide; lateral veins with spacing 7 mm or less………..2

2. Twigs 2–4 mm diameter; calyx ciliolate at margin; fruits fused at base with two parts diverging…………………………………………………………..…**1. O. ackeringae**
   Twigs 3.5–6 mm diameter; calyx not ciliolate at margin; fruits in pairs, sometimes with one absent………………………………………………………….…**2. O. glomerata**

1. **Ochrosia ackeringae** (Teijsm. & Binn.) Miq.

(J.E. Akkeringa, 1829–1864, a Dutch engineer who collected plants in Bangka)

Ann. Mus. Bot. Lugd. Bat. 4 (1869) 138; Backer & Bakhuizen *f. op. cit.* 232; Fosberg & Sachet, Adansonia 17 (1977) 29; Markgraf *op. cit.* (1979) 238; Hendrian *op. cit.* 117. **Basionym:** *Lactaria ackeringae* Teijsm. & Binn., Tijds. Ned. Ind. 29 (1867) 249. **Type:** *Ackeringa s.n.* (= *RHL Sheet No. 898111113*), Sumatra, Bangka (holotype L). **Synonyms:** *Ochrosia ackeringae* (Teijsm. & Binn.) Miq. var. *angustifolia* Baker *f. in* C.W. Andrews, Monogr. Christmas Isl. (1900) 182; *Ochrosia littoralis* Merr., Philip. J. Sci. 4 (1909) 315; *Bleekeria ackeringae* (Teijsm. & Binn.) Koidz., Bot. Mag. Tokyo 37 (1923) 52; *Bleekeria littoralis* (Merr.) Koidz. *op. cit.* 52; *Excavatia littoralis* (Merr.) Markgr., *op. cit.* (1927) 194.

Tree to 10 m tall. **Bark** brown, smooth; inner bark yellowish. **Sapwood** white. **Twigs** *2–4 mm diameter*, not lenticellate, glabrous. **Leaves** mostly in whorls of 3, rarely opposite, papery to coriaceous; *blade obovate to elliptic*, *2.1–4.6 times as long as wide*, 5.5–20 × 2.5–4.4 cm, base cuneate or decurrent onto petiole, *apex usually acuminate*, sometimes acute or cuspidate, very rarely to shallowly retuse; *lateral veins with 1–2 mm spacing*, more than 35 pairs, inconspicuous, not prominent; intercostal venation indistinct; petiole 0.4–1.6 cm long, glabrous. **Inflorescences** 2.5–10.7 cm long, in whorls of 2–3, repeatedly dichotomous, glabrous; flowers loose or congested; peduncles 1–6.9 cm long, glabrous. **Flowers** fragrant, 8–20 on each inflorescence; pedicels 2–2.5 mm long, glabrous, bracteolate; *sepals ciliolate*, ovate to broadly so, 1.9–2.3 × 1.5–2 mm, 0.9–1.5 times as long as wide, apex rounded, glabrous; corolla white, glabrous outside, pubescent inside, tube cylindrical, *c.* 12.5 mm long, lobes narrowly ovate, *c.* 12 × 3 mm, apex rounded or acute, glabrous; stamens inserted at *c.* 3 mm below the mouth of corolla tube, anthers *c.* 1.3 × 0.5 mm; pistil glabrous; ovary *c.* 1.9 mm high, style filiform, *c.* 6.5 mm long; pistil head *c.* 0.5 mm long. **Fruits** *V-shaped*, *carpels fused at base and then free ends diverging*, unequal in size, sometimes only one carpel developing, each mericarp ellipsoid or narrowly so, sometimes narrowly obovoid, 2–4.4 × 0.6–1.9 × 0.5–2 cm, apex acute or acuminate, smooth, glabrous, indehiscent, green and turning red when ripe; endocarps massive, hard, surrounding 2 lateral spongy cavities. **Seeds** 2–3 at either placenta, flat, suborbicular to ellipsoid, 0.4–0.9 × 0.3–0.6 cm, apex acuminate, glabrous, whitish-brown.

Distribution. Sumatra, Java, Borneo, the Philippines, Sulawesi, Maluku, New Guinea, and New Ireland. In Borneo, known only from Sabah (e.g., *SAN 18406*, *SAN 49136* and *SAN 68109*).

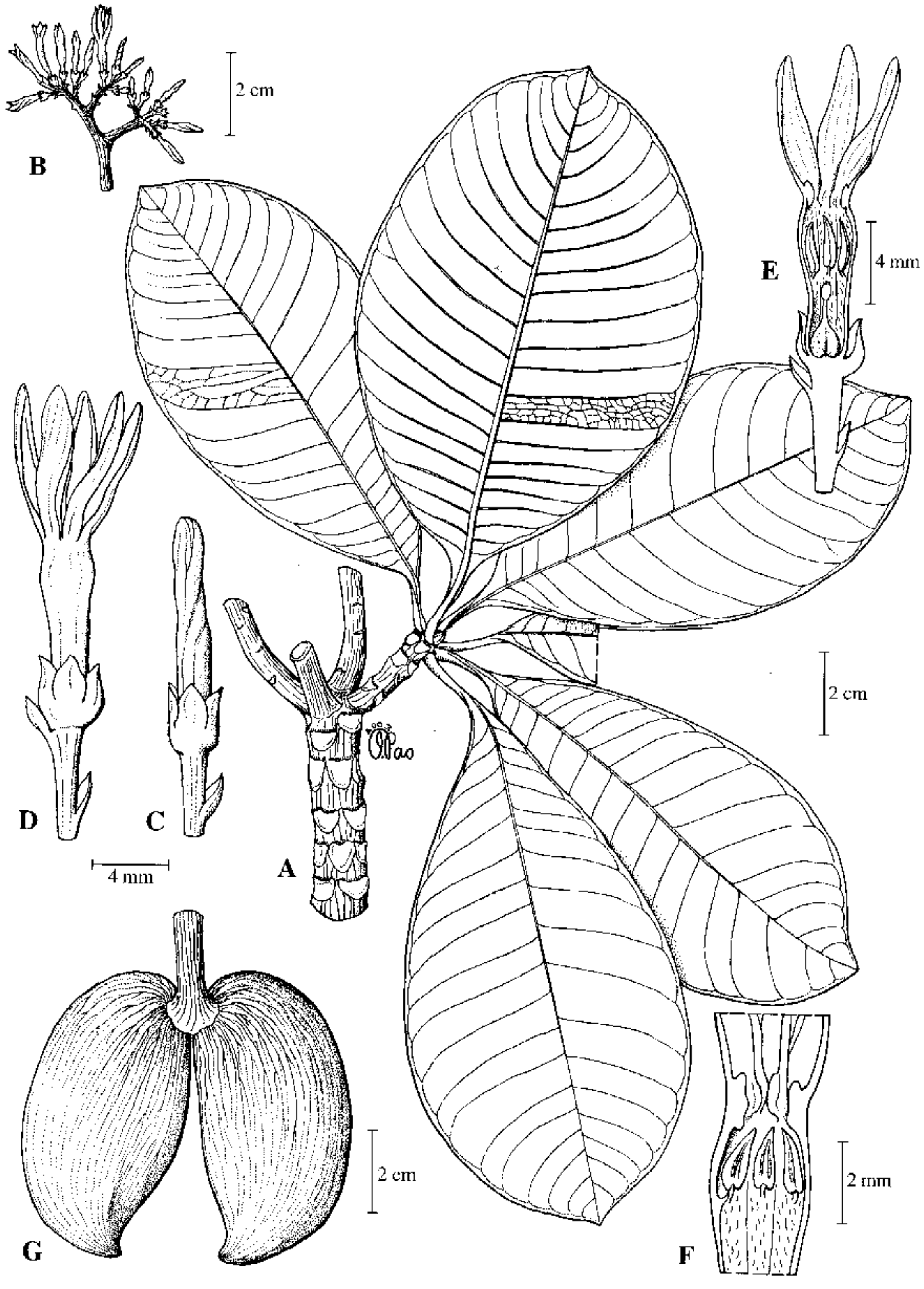

Fig. 7. *Ochrosia oppositifolia.* A, leafy twig; B, part of inflorescence; C, flower bud; D, partially open flower; E, longitudinal section of partially open flower; F, longitudinal section of corolla tube showing the attachment of stamens; G, fruits. (A–F from *KN 651*, G from *SAN 126254.*)

Ecology. In coastal forest and strand vegetation.

2. **Ochrosia glomerata** (Blume) Valeton

(Latin, *glomeratus* = collected into a head; referring to the congested flowers)

Ann. Jard. Bot. Buitenz. 12 (1895) 233; Hendrian *op. cit.* 112. **Basionym:** *Pseudochrosia glomerata* Blume *op. cit.* (1850) 158. **Type:** *Zippelius s.n.* (= *RHL Sheet No. 898111243*), West Papua (holotype L). **Synonyms:** *Neisosperma glomerata* (Blume) Fosberg & Sachet *op. cit.* 29, Markgraf *op. cit.* (1979) 246; *Lactaria glomerata* (Blume) Koidz., *op. cit.* 51.

Tree to 30 m tall, to 30 cm diameter. **Bark** pale greyish brown to blackish brown, smooth to lightly fissured; inner bark pale brown to yellowish. **Sapwood** yellowish. **Twigs** *3.5–6 mm diameter,* not lenticellate, glabrous. **Leaves** in whorls of 3–4, rarely opposite, coriaceous; *blade obovate to elliptic*, *2.1–5.8 times as long as wide*, 5.4–26 × 2.1–8 cm, base decurrent onto petiole, *apex usually acuminate*, sometimes acute, or very rarely shallowly retuse; *lateral veins with 1–7 mm spacing*, 28–45 pairs, conspicuous, slightly prominent below, forming a submarginal vein; intercostal venation often indistinct; petiole 0.6–5.3 cm long, glabrous. **Inflorescences** 1.5–18 cm long, in whorls of 2–4, sometimes solitary, congested, glabrous; peduncles 1–8 cm long, glabrous. **Flowers** fragrant, more than 30 on each inflorescence; pedicels *c.* 2 mm long, glabrous; *sepals not ciliate*, ovate, unequal in size, 1.5–2 × 1.3–2 mm, 1–1.1 times as long as wide, apex acute, glabrous on both sides; corolla white, glabrous outside, pubescent inside, tube cylindrical, *c.* 3 mm long, lobes narrowly elliptic, *c.* 8 × 2 mm, apex rounded, glabrous; stamens inserted at *c.* 1 mm below the mouth of corolla tube, anthers ovate to narrowly so, 1.5–1.8 × 0.5 mm; pistil glabrous; ovary *c.* 1 × 1 mm, style filiform, *c.* 1 mm long; pistil head *c.* 0.5 mm long. **Fruits** *of 2 separate mericarps*; mericarps blackish brown or brown when dried, ovoid, ellipsoid, or subglobose, 4.1–7.6 × 1.8–3.5 × 1.7–3.5 cm, base rounded to blunt, apex apiculate, acumen often strongly curled, glabrous, rather glossy, indehiscent, green and turning yellow or orange when ripe; endocarps splitting into fibres which penetrate the mesocarps; fibres rather thin and slender, not forming hard thick pointed ends. **Seeds** 2 at either placenta, flat, suborbicular to ellipsoid, 1.3–3 × 1–2.1 cm, apex acuminate, glabrous, whitish.

Distribution. Borneo, the Philippines, Maluku, and New Guinea. In Borneo, only known from Sabah (e.g., *SAN 21666*, *SAN 36023*, *SAN 47675*, *SAN 57436*, and *SAN 117472*).

Ecology. In primary and secondary forests, and more open areas, on a variety of soil types at altitudes to 900 m.

3. **Ochrosia oppositifolia** (Lam.) K.Schum. Fig. 7.

(Latin, *oppositus* = opposite, *folius* = leaves; with opposite leaves)

In Engler & Prantl, Nat. Pflanzenfam. 4, 2 (1895) 156; Merrill, Enum. Philip. Fl. Pl. 3 (1923) 330; Backer & Bakhuizen *f. op. cit.* 232; Ashton *op. cit.* 40; Corner *op. cit.* 157; Middleton *op. cit.* 65; PROSEA *op. cit.* 389; Hendrian *op. cit.* 113. **Basionym:** *Cerbera oppositifolia* Lam., Encycl. 1 (1783) 62. **Type:** *Rumphius Herb. Amboin. 2* (*1742*) *255*, *t. 84*. **Synonyms:** *Lactaria oppositifolia* (Lam.) Kuntze, Rev. Gen. (1891) 415; *Neisosperma oppositifolia* (Lam.) Fosberg & Sachet, Micronesica 8 (1972) 48, Markgraf *op. cit.* (1979) 243. (For other synonyms, *cf.* Middleton *op. cit.* 65).

Tree 6–18 m tall, to 30 cm diameter, sometimes with small buttresses. **Bark** grey or brown, smooth, slightly fissured; inner bark green, yellowish or reddish. **Sapwood** white, khaki or pale orange. **Twigs** (*4–*)*6–9 mm diameter*, not lenticellate, glabrous. **Leaves** in whorls of 3–4(–5), papery or coriaceous; *blades usually obovate*, *very rarely elliptic*, *6.5–36 × 3.4–18 cm*, *1–3 times as long as wide*, base decurrent onto petiole, *apex mostly rounded*, *more rarely acuminate*, *sometimes retuse*; *lateral veins with 2–15 mm spacing*, 21–42 pairs, conspicuous on both sides, not prominent, with a distinct intramarginal vein; intercostal venation rather inconspicuous; petiole 1.5–6.6 cm long, glabrous. **Inflorescences** 2–17 cm long, in whorls of 2–4, glabrous, flowers congested; peduncles 1–10.5 cm long, glabrous. **Flowers** fragrant, more than 30 per inflorescence; pedicels 2.1–4 mm long, glabrous; sepals ovate, 2–2.3 × 1.8–2 mm, apex rounded, glabrous on both sides; corolla white, creamy white, or yellowish white, glabrous outside, pubescent inside, tube cylindrical, 5.3–7 mm long, lobes narrowly elliptic, 9–12 × 3.5–4 mm, apex rounded, glabrous; stamens inserted at 2–2.5 mm below the mouth of corolla tube, anthers ovate to narrowly so, 1.2–1.5 × 0.5–0.8 mm; pistil glabrous; ovary *c.* 1 × 1 mm, style filiform, 1–1.9 mm long; pistil head 0.5–0.6 long. **Fruits** of 2 separate mericarps; mericarps blackish brown or light brown when dried, ovoid to ellipsoid, sometimes subglobose, 5–8.5 × 3–5.1 × 2.8–4 cm, apex apiculate, acumen strongly curled, sometimes acuminate, glabrous, indehiscent, green and turning yellow or orange when ripe; endocarps splitting into fibres which penetrate the mesocarps; fibres hard and thick or rather thin and slender, forming hard thick pointed ends or not. **Seeds** often one at either placenta, flat, suborbicular to ellipsoid, 2.6–3.8 × 1.9–2.9 cm, rarely with a small second one, flat, ellipsoid, 1–2.5 × 0.7–1.7 cm, apex acuminate, glabrous, brown.

Distribution. Sri Lanka, India (Andaman Is.), S Thailand through Malesia to Solomon Is., Marianne Is., New Hebrides, Fiji, Samoa, and Tonga Is. In Borneo, recorded from Sabah (e.g., *SAN 84736*, *SAN 126047*, *SAN 126254*, *SAN 126798*, and *SAN 126966*) and Sarawak (e.g., *S 20899* and *S 41811*).

Ecology. Coastal vegetation on sandy and rocky shores.

Notes. Ironically *Ochrosia oppositifolia* is the only one of the three species occurring in Sabah and Sarawak which never has opposite leaves!

7. RAUVOLFIA L.

(L. Rauvolf, 1540–1596, an Austrian botanist)

Sp. Pl. (1753) 208; King & Gamble, J. As. Soc. Beng. 74, 2 (1907) 423; Ridley, FMP 2 (1923) 335; Backer & Bakhuizen *f.*, FJ 2 (1965) 230; Whitmore, TFM 2 (1973) 20; Anderson, CLTS (1980) 149; Markgraf, Blumea 30 (1984) 157; Ashton, MNDTS 2 (1988) 40; Corner, WSTM 3rd. edition 1 (1988) 158; Whitmore, Tantra & Sutisna, CLK 1 (1990) 26; Middleton, Fl. Thailand 7 (1999) 50; Hendrian & Middleton, Blumea 44 (1999) 450; PROSEA 12, 1 (1999) 424; Beaman *et al.*, PMK 4 (2001) 110. **Synonyms:** *Ophioxylon* L., *op. cit.* 1043; *Dissolena* Lour., Fl. Cochinch. (1790) 137; *Cyrtosiphonia* Miq., Fl. Ned. Ind. 2 (1856) 401; *Heurckia* Müll.Arg., Flora 53 (1870) 168.

Shrubs, *trees or*, *sometimes*, *rhizomatous undershrubs*, *with white latex*. **Bark** smooth, rough, fissured or scaly. **Twigs** lenticellate. **Leaves** *in whorls of 3–7*, *often confined to the apices of the twigs*, *sometimes opposite on the lower nodes*, very rarely all opposite, glabrous, *without a small flap inside the base of petiole*; *blade papery to coriaceous*, *margin entire*; *lateral veins arcuate-ascending or straight*. **Inflorescences** *terminal*, *sometimes seemingly lateral*, *few- to many-flowered cymes*, *flowers lax or congested*, glabrous or pubescent. **Flowers:** *sepals connate only at base*, glabrous or pubescent outside, glabrous inside, ciliate or not; *corolla salver-shaped*, *tube longer than the lobes*, glabrous outside, variably hairy inside, *lobes overlapping to the left in bud*; stamens free from each other or from the pistil, included or exserted, *anthers without a long appendage*; *disc cup-shaped*, *entire*; *ovary* superior, *composed of two free to completely fused carpels*, style filiform, glabrous to pubescent; pistil-head cylindrical with a membranous collar at the base. **Fruits** *of two separate or two almost completely fused drupes*, often only one carpel developing, each carpel contains a single seed. **Seeds** *simple*, laterally compressed, obliquely ovoid or ellipsoid.

Distribution. A pantropical genus of *c.* 60 species. The genus is represented by two species in Sabah and Sarawak.

Ecology. Primary and secondary lowland to montane forests on a variety of soil types, at altitudes to 2000 m.

Uses. *Rauvolfia* has been used in Ayurvedic medicine since ancient times to treat snake bites, mental diseases and epilepsy. In Vietnam extracts of the plants are mainly used as an anti-hypertensive agent and as a tranquilizer. In other parts of its geographical range an extract from the roots is considered to be an effective remedy against high blood-pressure. Other medicinal uses include treatments for dysentery, diarrhoea, liver diseases, insanity and cholera. In modern medicine, *Rauvolfia* species (e.g., *R. serpentina*, *R. sumatrana* and *R. verticillata*) are used as a source of the alkaloids reserpine, ajmalicine and ajmaline. Reserpine is marketed for the treatment of arterial hypertension; ajmalicine as an ingredient of propietary products used to treat psychological and behavioural problems associated with senility, and sensory problems; and ajmaline is used as a remedy for heart arrhythmias. The wood is used for making small objects such as knife-handles (For more details see PROSEA 12, 1 (1999) 424).

Key to *Rauvolfia* species

Leaf blade coriaceous; lateral veins more or less straight, 9–32 pairs; corolla tube less than 6 mm long; ovary syncarpous……………………………………………**1. R. sumatrana**

Leaf blade papery or, rarely, subcoriaceous; lateral veins arcuate-ascending, 6–13 pairs; corolla tube more than 8 mm long; ovary of 2 separate carpels……………**2. R. verticillata**

1. **Rauvolfia sumatrana** Jack Fig. 8.

(of Sumatra)

Mal. Misc. 1, 5 (1820) 22; King & Gamble *op. cit.* 424; Ridley *op. cit.* 336; Masamune, EPB (1942) 624; Anderson *op. cit.* 149; Markgraf *op. cit.* 167; Whitmore, Tantra & Sutisna *op. cit.* 26; Turner, Gard. Bull. Sing. 47 (1995) 128; Middleton *op. cit.* 53; Hendrian & Middleton *op. cit.* 462; Beaman *et al. op. cit.* 110. **Neotype** (Markgraf, 1984)**:** *Diepenhorst s.n.*, W Sumatra, Pariaman (K). **Synonyms:** *Rauvolfia sumatrana* Jack var. *longifolia* Blume, Bijdr. Fl. Ned. Ind. (1826) 1034; *R. reflexa* Teijsm. & Binn., Nat. Tijds. Ned. Ind. 3 (1852) 329, Whitmore *op. cit.* 21, Markgraf *op. cit.* 164, Ashton *op. cit.* 41; *Cyrtosiphonia sumatrana* (Jack) Miq., *op. cit.* 401; *C. reflexa* (Teijsm. & Binn.) Miq., *op. cit.* 402; *C. spectabilis* Miq., *op. cit.* 402; *R. spectabilis* (Miq.) Boerl., Handl. Fl. Ned. Ind. 2 (1899) 393, Merrill, EB (1921) 500, Masamune *op. cit.* 624; *R. samarensis* Merr., Philip. J. Sci., Bot. 4 (1900) 316, PEB (1929) 254, Masamune *op. cit.* 623, Markgraf *op. cit.* 165.

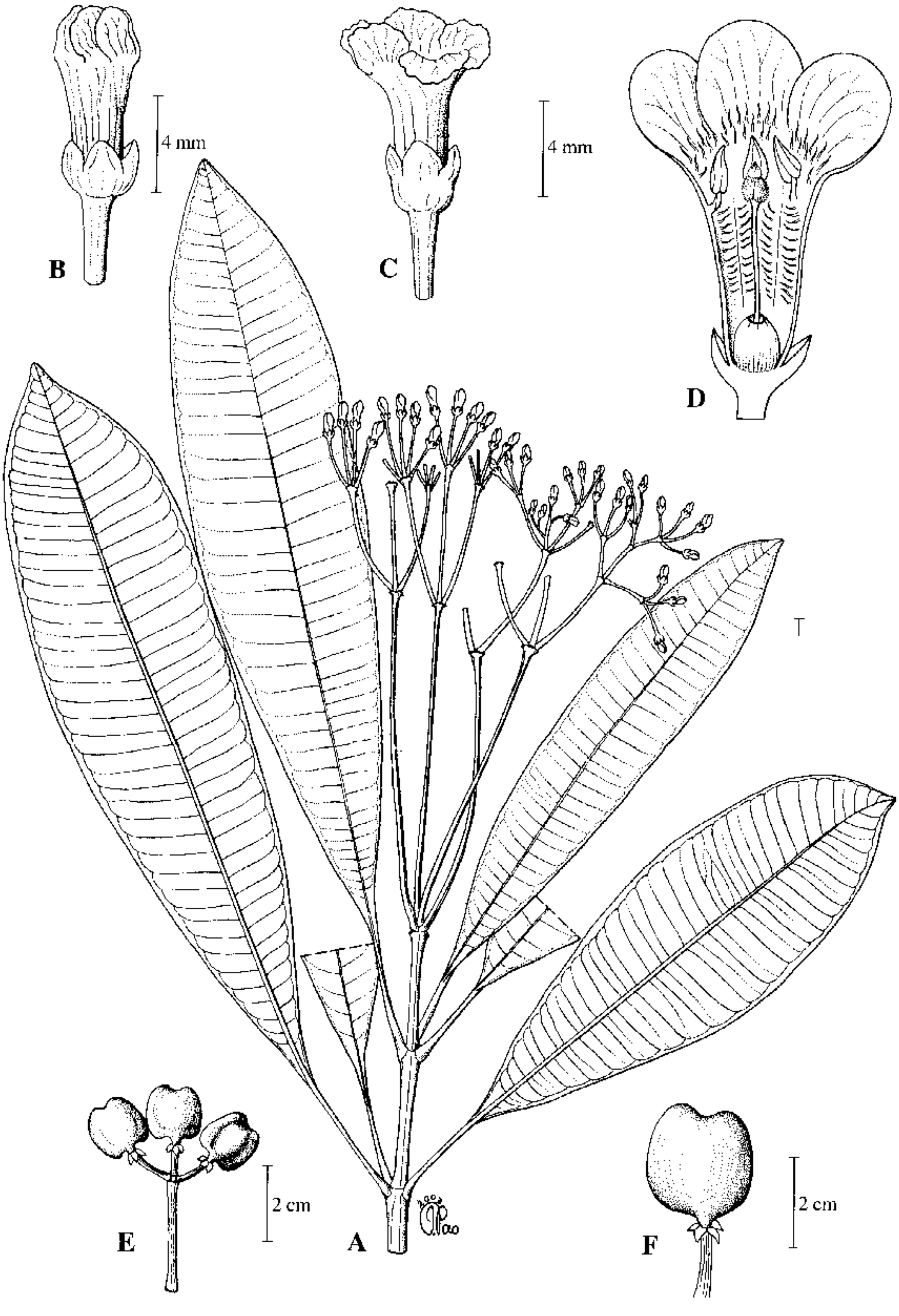

Fig. 8. *Rauvolfia sumatrana*. A, flowering leafy twig; B, flower bud; C, open flower; D, longitudinal section of open flower; E, infructescence; F, fruit. (A from *SAN 89977*, B–D from *S 65435*, E–F from *S 34584*.)

Tree to 27 m tall, to 43 cm diameter. **Bark** grey, yellowish grey, greenish yellow or brown, smooth, slightly fissured or flaky; inner bark white or yellowish. **Sapwood** white, cream, red or brown. **Twigs** rather densely lenticellate, glabrous. **Leaves** in whorls of 3 or 4, *coriaceous*; blade elliptic to obovate, 7–31 × 2–9.3 cm, base cuneate to decurrent, apex acute, acuminate, rarely rounded, retuse, or emarginate; *lateral veins 9–32 pairs*, with 0.15–1(–1.5) cm spacing, more or less prominent, conspicuous, *straight*, *or slightly arcuate-ascending*, forming an angle of 45–90° with the midrib, anastomosing and forming a submarginal vein; intercostal venation not prominent but conspicuous; petiole 0.6–5.2 cm long, glabrous. **Inflorescences** (2.5–)5–21.5(–27) cm long, in whorls of 3–5(–6), 26–35 (or more)-flowered; peduncles 1.8–14 × 0.2–0.25 cm. **Flowers:** pedicels 0.1–1.2 cm long, glabrous; sepals mostly broadly ovate or suborbicular, 1–2 × 1.4–2 mm, 0.5–1.3 times as long as wide, apex obtuse to rounded, rarely acute, entire to undulate, connate at base for 1 mm; corolla white, glabrous outside, pubescent in a belt of 1.5–2 mm wide just at the mouth, and gradually turning sparsely so downwards, *tube cylindrical*, *3.4–4.9 mm long*, broader towards the apex, lobes obliquely and broadly ovate, or suborbicular, 1.3–2.1 × 1.3–2.1 mm, 0.7–1 times as long as wide, apex rounded, rarely retuse; stamens inserted at 2.5–4.5 mm from base of corolla tube, anthers 0.9–1.5 × 0.25–0.7 mm, 1.6–4 times as long as wide; disc cup-shaped, 1–1.8 × 0.7–1.4 mm, 0.6–0.9 times as long as ovary, crenate; *ovary syncarpous*, ovoid, 1–1.75 mm long, style plus pistil head 1.9–3.4 mm long. **Fruits** bluish black or purplish black when mature, syncarpous, globose, rounded, sometimes truncate, retuse or slightly cleft at apex, rarely ovoid or ellipsoid, 6.5–21 × 7–18 mm, 0.9–1.8 times as long as wide, connate for 6–11.7 mm, 0.9–1 of its length; endocarps two layers, sometimes only one developing.

Distribution. Myanmar, Thailand, Sumatra, Peninsular Malaysia, Borneo, Java, Nusa Tenggara, Sulawesi, Maluku, and the Philippines. In Borneo, widespread in Sabah (e.g., *SAN 30007*, *SAN 44652*, *SAN 81149*, *SAN 88631*, *SAN 106815*, and *SAN 114285*), but localised in Sarawak (e.g., *Chew WL 689*, *S 41876* and *S 65435*) and Kalimantan (e.g., *Kostermans 4862* and *Kuswata 985*).

Ecology. In open areas, scrub, and a variety of primary and secondary forests on many different soil types. Mostly lowland.

2. **Rauvolfia verticillata** (Lour.) Baill.

(Latin, *verticillatus* = whorled; with whorled leaves)

Bull. Mens. Soc. Linn. Paris 1 (1888) 768; Whitmore *op. cit.* 21; Markgraf *op. cit.* 160; Whitmore Tantra & Sutisna *op. cit.* 26; Turner *op. cit.* 129; Middleton *op. cit.* 54; Hendrian & Middleton *op. cit.* 464; Beaman *et al. op. cit.* 110. **Basionym:** *Dissolena verticillata* Lour., *op. cit.* 137. **Lectotype** (Markgraf, 1984)**:** *Loureiro s.n.*, China, Canton (hololectotype BM; isolectotype P). **Synonyms:** *Rauvolfia serpentina* (L.) Benth. *ex* Kurz var. *gracilis* Stapf, FMK (1894) 207, Merrill *op. cit.* (1921) 499, Masamune *op. cit.* 623; *R. perakensis* King & Gamble *op. cit.* 424, Ridley *op. cit.* 335, Corner *op. cit.* 158. (For other synonyms, *cf.* Middleton *op. cit.* 54 and Hendrian & Middleton *op. cit.* 465).

Shrub to 5 m tall. **Bark** yellowish black or brown; inner bark greenish. **Sapwood** whitish or yellowish. **Twigs** slightly rough, slightly lenticellate, glabrous. **Leaves** confined to the apex of twigs, usually in whorls of 3 or 4, sometimes also opposite, glabrous; *blade papery*, obovate or elliptic, sometimes narrowly so, 5–25 × 2.2–10 cm, 2–4.5(–6.5) times as long as wide, base cuneate to slightly decurrent, apex acuminate to cuspidate; midrib prominent on both sides; *lateral veins 6–13 pairs*, with 0.5–2.5 cm spacing, prominent on both sides, *arcuate-ascending*, rarely straight, forming an angle of (45–)55–85° with the midrib, not reaching the margin or sometimes joining near the margin to form a submarginal vein; petiole 0.2–2 cm long, glabrous. **Inflorescences** 3–12 cm long, usually in whorls of 3 or 4, rarely solitary, 8–24(–35 or more)-flowered, flowers lax; peduncles 3–7.7 × 0.1–0.2 cm, rather delicate, glabrous. **Flowers:** pedicels 0.2–1.2 cm long, glabrous; sepals ovate to narrowly ovate, 2–5.5 × 0.8–1 mm, 2–7 times as long as wide, apex acute to acuminate; corolla white or slightly pinkish, glabrous outside, *tube cylindrical*, *9–17 mm long*, straight to slightly twisted, swollen around the stamens, lobes suborbicular to obliquely ovate, 2–4.5(–6.5) × 2–3.5(–6) mm, 1–1.5 times as long as wide, apex obtuse to rounded; stamens inserted at 6–10 mm from base of corolla tube, anthers 1–1.5 × 0.3–0.6 mm, 2.2–4.3 times as long as wide; disc cup-shaped, 0.8–1.4 high, 0.4–0.6 times as long as ovary, slightly crenate, sometimes thicker at the edge; *ovary consisting of two carpels which are free from each other*, ovoid, 1.2–2.1 mm long, style plus pistil head 4.6–7.6 mm long. **Fruits** whitish purple when mature, usually of paired mericarps free from each other, with a very short stalk, sometimes only one carpel developing, ovoid, 9–14 × 4.5–7 mm, 1.7–2.5 times as long as wide, apex acute to obtuse.

Distribution. India, Sri Lanka, Myanmar, Thailand, China, Laos, Cambodia, Vietnam, Sumatra, Peninsular Malaysia, Borneo, Java, Nusa Tenggara, Sulawesi, and the Philippines. In Borneo, widespread in Sabah (e.g., *KEP 71620*, *SAN 32332*, *SAN 131437*, *SAN A 1659*, and *Stevens et al. 663*) but localised in Sarawak (e.g., *S 50523*).

Ecology. In open areas, lowland and montane rain forests on a variety of soils, at altitudes to 2000 m.

8. **TABERNAEMONTANA** L.

(Jakob Dietrich of Bergzabern, died 1590, a German botanist—
Tabernaemontana is the latinisation of Bergzabern)

Sp. Pl. (1753) 210; Whitmore, TFM 2 (1973) 21; Anderson, CLTS (1980) 149; Ashton, MNDTS 2 (1988) 41; Corner, WSTM 3rd. edition 1 (1988) 159; Leeuwenberg, J. Ethnopharm. 10 (1984) 1, Agric. Univ. Wag. Pap. 87-5 (1988) 1, Rev. *Tabernaemontana* 1 (1991) 1; Kessler & Sidiyasa, TBSA-EK (1994) 54; Coode *et al.* (eds.), CLBD (1996) 28; Argent *et al.* (eds.), MNDT-CK 1 (1997) 83; Middleton, Fl. Thailand 7 (1999) 27; PROSEA 12, 2 (2001) 530; Beaman *et al.*, PMK 4 (2001) 111. **Synonyms:** *Tabernaemontana* sect. *Ervatamia* A.DC. *in* DC., Prod. 8 (1844) 373; *Ervatamia* (A.DC.) Stapf, Fl. Trop. Afr. 4, 1 (1902) 126, King & Gamble, J. As. Soc. Beng. 74, 2 (1907) 447, Ridley, FMP 2 (1923) 340, Backer & Bakhuizen *f.*, FJ 2 (1965) 228, Cockburn, TS 1 (1976) 13; *Pagiantha* Markgr., Notizbl. Bot. Gart. Mus. Berl. 12 (1935) 549.

Shrubs or small trees. **Bark** with copious white latex. **Twigs** glabrous or sparsely pubescent. **Leaves** *opposite*, *often a pair unequal in size*, *with distinct but small stipule-like flaps inside the base of petiole*; blade papery to coriaceous, elliptic to obovate; lateral veins arching upwards towards margins, weakly anastomosing near margin. **Inflorescence** a cyme or solitary flower, lax; 2 inflorescences at each ramification, occasionally with one missing. **Flowers** usually fragrant; *sepals free except at the very base*, often with glands inside; corolla in mature bud with a narrow tube and globose to ovoid head, in bud lobes overlapping to the left and folded inwards, mature corolla salver-shaped; stamens subsessile or with short filaments, completely included in the corolla tube, anthers narrowly triangular to oblong, base cordate, apex acute, fertile for the entire length, free from the pistil; *disc absent*; ovary of two separate carpels united into a common style, style filiform, pistil head short. **Fruits** of paired follicles, sometimes connate by their bases, obliquely ellipsoid to somewhat elongated, ridged or smooth, sometimes torulose. **Seeds** *covered in a fleshy aril*.

Distribution. About 99 species, found throughout the aseasonal and seasonal tropics in evergreen and deciduous forests. In Borneo, one introduced and six native species are known; all six native species occur in Sabah but only four occur in Sarawak.

Ecology. Mostly understorey shrubs or small trees.

Uses. The most common use is in horticulture, particularly *T. divaricata* and *T. pandacaqui*. A number of species are used to treat nose ulcerations and boils and for hypertension, inflammations and fevers.

Taxonomy. The generic limits of *Tabernaemontana* are still somewhat controversial, with some authors preferring to recognise a number of segregate genera. Large numbers of species have been described in *Tabernaemontana* and its various segregate genera, many of which have now been synonymised with the result that many of the still recognised species are very widespread, variable and have long lists of synonyms. Synonyms have only been given if based on specimens from the western parts of Malesia. (Full synonymy can be found in Leeuwenberg, Rev. *Tabernaemontana* 1 (1991) 1–201).

Key to *Tabernaemontana* species

1. Leaf blade mostly thickly coriaceous, apex usually apiculate to rounded; lateral veins more or less straight; sepals not much longer than wide; fruits more than 5 cm wide…...
……………………………………………………………………...…**3. T. macrocarpa**
Leaf blade papery or subcoriaceous, apex usually acuminate or caudate; lateral veins curved-ascending; sepal ratio variable; fruits less than 3.5 cm wide……………………2

2. Cultivated plants; corolla sometimes doubled; stamens frequently inserted in the lower third of corolla tube……………………………………………………………………….

T. divaricata (L.) R.Br. *ex* Roem. & Schult.

(Latin, *divaricatus* = spreading at a wide angle; referring to the corolla lobes)

Syst. 4 (1819) 427; Merrill, EB (1921) 498; Masamune, EPB (1942) 624; Backer & Bakhuizen *f.*, *op. cit.* 228; Corner *op. cit.* 161; Turner, Gard. Bull. Sing. 47 (1995) 129; Leeuwenberg *op. cit.* (1991) 153; PROSEA *op. cit.* 535. Basionym: *Nerium divaricatum* L., *op. cit.* 209. Lectotype (Leeuwenburg, 1984): *Herb. Hermann 1: 7* (hololectotype BM).

Shrub or small tree to 5 m tall, 3–10 cm diameter. Leaves opposite, of equal or unequal size, petiolate. Inflorescences pedunculate, 1–30-flowered, rather lax, 3–14 cm long. Flowers sweet-scented, open during the day; sepals pale green, connate at base to about two thirds of the length, inside with 1–4 colleters in one row *c.* 1 mm above the base; *corolla sometimes doubled*, white, often with a yellow throat, tube 15–27 mm long, lobes mostly falcate, spreading, 15–27 × 8–20 mm; *stamens inserted in the lower third of corolla tube*. Fruits of 2 separate follicles; follicles orange, red or less often green, obliquely narrowly ellipsoid or pod-like, 20–70 × 6–15 × 6–15 mm. Seeds obliquely ellipsoid, 7–8 × 4–6 × 3–4 mm, longitudinally grooved.

Native of NE India, Nepal, Bhutan, Bangladesh, Myanmar, Thailand, Laos, and China (Yunnan). Widely cultivated as garden plants in the tropics throughout the world.

Wild plants; corolla never doubled; stamens inserted in the upper two thirds of corolla tube……………………………………………………………………………………3

3. Leaves generally drying yellowish; lateral veins 6–9 pairs; corolla tube 4.5–5.2 mm long; fruit 1–2(–rarely 3)-seeded………………………………….…**1. T. antheonycta**

Leaves mostly drying dark brown, brownish or greenish, sometimes yellowish; lateral veins 5–16 pairs; corolla tube more than 8 mm long; fruit 1–many-seeded…………..…4

4. Sepals not ciliate, 4–10 mm long, leafy and often cordate, or linear but always narrower at the base than in the middle……………………………………………….……………….

T. rostrata Roxb. *ex* Wall.

(Latin, *rostratus* = beaked; possibly in reference to the fruit)

Bot. Reg 15 (1829) *sub t.* 1273; Middleton *op. cit.* 36; PROSEA *op. cit.* 537; Beaman *et al. op. cit.* 112. Type: *Wallich 1578*, Myanmar, Segaing, Irawaddy R. (holotype K-W; isotypes BM, G-DC, K). Synonyms: *Ervatamia corymbosa* Roxb. *ex* Wall. var. *kelsallii* King & Gamble *op. cit.* 449; *E. cylindrocarpa* King & Gamble *op. cit.* 452, Ridley *op. cit.* (1923) 344; *E. curtisii* King & Gamble *op. cit.* 453, Ridley *op. cit.* (1923) 344; *Tabernaemontana cylindrocarpa* (King & Gamble) Merr., Pap. Mich. Acad. Sci. 20 (1935) 107, Corner *op. cit.* 161; *E. rostrata* (Wall.) Markgr., *op. cit.* 547; *T. crispa auct. non* Roxb.: Hooker *f.*, Fl. Brit. Ind. 3 (1882) 648, Leeuwenberg *op. cit.* (1991) 145. (For further synonymy, *cf.* Leeuwenberg *op. cit.* (1991) 145, under *T. crispa*).

Shrub to 2 m tall. Twigs sparsely lenticellate, glabrous. Leaves glabrous, papery; blade elliptic, 6–20.5 × 2.5–6.5 cm, base cuneate, apex acuminate; lateral veins 4–11 pairs, weakly anastomosing near margin; intercostal venation mostly obscure; petiole 2–20 mm long. Inflorescences 4.6–18 cm long. Flowers: *sepals 4–10 mm long*, *3–6 times as long as broad*, ovate to linear, apex obtuse or rounded, *base cordate or not*, *often leafy*, *not ciliate*; corolla white, in mature bud 1.4–2.6 cm long with an ovoid head 0.2–0.4× the length of bud, apex rounded or obtuse, glabrous on both sides or pubescent around stamen insertion, tube 1.3–2.2 cm long, twisted or not, lobes 10–20 × 2.5–10 mm, apex rounded; stamens inserted around the middle or upper half of corolla tube, anthers 2–3 × 0.5–0.8 mm; ovary 1–1.2 mm long, style and pistil head 5–14 mm long. Fruits shortly stipitate, apex acuminate, torulose, 2–7 × 0.7–2.3 cm, several-seeded. Seeds ovoid, 7–10 × 4.5–6 mm.

India (Andaman and Nicobar Is.), Myanmar, Thailand, Vietnam, Sumatra, Peninsular Malaysia, Borneo and the Philippines. In Borneo, widespread in Sabah (e.g., *SAN 114295*, *SAN 117225*, *SAN 118953*, *SAN 123566*, and *SAN 141178*). Not yet known from Sarawak. In scrub or forest at altitudes to 1400 m.

Sepals minutely ciliate or not, 1–5 mm long, not narrower at the base than in the middle ……………………………………………………………………………………...…5

5. Corolla lobes minutely ciliate, at least in the lower half; flower robust; sepals ciliate….. ………………………………………………………………………….…**2. T. corymbosa**

Corolla lobes not ciliate; flower robust or slender; sepals ciliate or not……………...…6

6. Lateral veins frequently much paler than the blade above; head of mature corolla bud rounded or obtuse; sepals minutely ciliate or not…………………...…**4. T. pandacaqui**

Lateral veins generally of the same colour as or only slightly paler than the blade; head of mature corolla bud acute or acuminate; sepals usually not ciliate…...**5. T. pauciflora**

1. **Tabernaemontana antheonycta** Leeuwenberg

(Greek, *anthos* = flower, *nyctios* = of the night; referring to night-time flowering)

Rev. *Tabernaemontana* 1 (1991) 117; Coode *et al.* (eds.) *op. cit.* 28. **Type:** *Sibat S 23639*, Borneo, Sarawak, Balingian, Mt. Iju (holotype L; isotypes A, BO, K, KEP, SAN, SAR, SING).

Shrub or small tree to 5 m tall. **Bark** grey, smooth; inner bark pale brown. **Sapwood** pale brown. **Twigs** lenticellate, glabrous. **Leaves** *subcoriaceous*, *mostly drying yellowish*, glabrous; blade narrowly elliptic, 4–19 × 1–6 cm, 2.5–6.3 times as long as wide, base cuneate, *apex acuminate*; *lateral veins 6–9 pairs*, *curved-ascending*, often somewhat obscure above; intercostal venation obscure; petiole 2–15 mm long. **Inflorescences** few-flowered, 3–11.4 cm long, delicate with a long thin peduncle to 6 cm long, glabrous, not densely lenticellate. **Flowers:** pedicels 4–6 mm long; sepals ovate, 1–1.2 × 0.8–1 mm, apex rounded, glabrous, ciliate, without glands inside; *corolla never doubled*, pale yellow to white, in mature bud 6–7 mm long with small, globose head *c.* 0.25× the length of bud, apex rounded, *tube 4.5–5.2 mm long*, lobes obliquely elliptic, 3.5–5 × 0.9–1.4 mm, glabrous on both sides; *stamens inserted in the upper two thirds of corolla tube*, anthers *c.* 1.2 × 0.4 mm; ovary glabrous, *c.* 1.2 mm long, style *c.* 0.1 mm long; pistil head *c.* 0.7 mm long. **Fruits** of paired follicles, orange, obliquely obovoid, *15–32 × 8–18 mm*, with or without ridges, *1–2–*(*3*)*-seeded*.

Vernacular name. Sarawak—*kerimpa patong* (Iban).

Distribution. Endemic in Borneo and known from Sabah (e.g., *SAN 58740*), Sarawak (e.g., *S 16766*, *S 23639*, *S 24626*, *S 41796*, and *S 44006*) and Brunei (e.g., *BRUN 498* and *Wong WKM 1073*).

Ecology. In lowland mixed dipterocarp forest at altitudes to 250 m.

Note. The name implies, and the protologue states, that the flowers in this species only open at night, a conclusion reached because no open flowers were seen on the specimens studied. However, open flowers have now been seen on specimens with no indication on the label that the specimen was collected at night. Further study is needed to elucidate this.

2. **Tabernaemontana corymbosa** Roxb. *ex* Wall.

(Latin, *corymbosus* = corymbose; with the flowers in corymbs)

Bot. Reg. 15 (1829) *t.*1273; Whitmore *op. cit.* 23; Corner *op. cit.* 161; Leeuwenberg *op. cit.* (1988) 5, *op. cit.* (1991) 138; Turner *op. cit.* 129; Middleton *op. cit.* 31; PROSEA *op. cit.* 534; Beaman *et al. op. cit.* 111. **Type:** *Wallich 1572* (holotype K-W; isotypes BM, CGE, E, K, SING). **Synonyms:** *Tabernaemontana hirta* Hook.*f.*, *op. cit.* 646; *Ervatamia corymbosa* (Roxb. *ex* Wall.) King & Gamble *op. cit.* 448, Ridley *op. cit.* (1923) 341; *E. hirta* (Hook.*f.*) King & Gamble *op. cit.* 449, Ridley *op. cit.* (1923) 342, Whitmore *op. cit.* 23; *E. corymbosa* Roxb. *ex* Wall. var. *pubescens* King & Gamble *op. cit.* 449; *T. sumatrana* (Miq.) Hallier *f.*, Bot. Jahrb. 49 (1913) 375; *E. pauciflora* Blume var. *minor* Ridl., J. As. Soc. Str. Br. 86 (1922) 300, Ridley *op. cit.* (1923) 343; *E. pauciflora auct. non* Blume:

Ridley *op. cit.* (1923) 342; *Pagiantha corymbosa* (Roxb. *ex* Wall.) Markgr., *op. cit.* 546. (For further synonymy, *cf.* Leeuwenberg *op. cit.* (1991) 138).

Tree to 12 m tall, to 20 cm diameter. **Bark** dark brown, shallowly fissured. **Twigs** lenticellate, glabrous, rarely pubescent. **Leaves** *subcoriaceous to papery*, *drying dark brown*, glabrous or, rarely, sparsely pubescent below; blade elliptic to obovate, 7–30 × 2–14 cm, 2–6 times as long as wide, base cuneate, *apex acuminate to caudate*; *lateral veins 6–16 pairs*, *curved-ascending*, weakly anastomosing before reaching the margin; intercostal venation irregularly scalariform or more or less obscure; petiole 3–20 mm long. **Inflorescences** 2–25-flowered, 5–13 cm long, glabrous to pubescent; axes lenticellate or not. **Flowers:** pedicels 5–30 mm long; *sepals ovate*, *2–5 × 1–2.5 mm*, apex acute to rounded, *ciliate*, otherwise glabrous outside; *corolla never doubled*, white, in mature bud 1.7–3.2 cm long with ovoid to subglobose head 0.25–0.33× the length of bud, apex obtuse, *tube 15–31 mm long*, *lobes* 9–16 × 4–10 mm, apex rounded, pubescent at least at base inside, *usually ciliate*; *stamens inserted at 13–23 mm from the base of corolla tube*, anthers 2–5 × 0.5–1.5 mm; ovary glabrous or with a few hairs, 1.5–2 mm long, style 10–16 mm long; pistil head 1.5–2.2 mm long. **Fruits** of 2 separate follicles, red or yellow, *2–4.5 × 0.6–3 cm*, with or without ridges, *5–20-seeded*. **Seeds** with a red or orange aril.

Distribution. S China, Myanmar, Vietnam, Laos, Thailand, Sumatra, Peninsular Malaysia, Singapore, Borneo, and Nusa Tenggara. In Borneo, common in Sabah (e.g., *SAN 28710*, *SAN 34638*, *SAN 68577*, *SAN 78113*, *SAN 82546*, and *SAN 109388*) and Sarawak (e.g., *S 22662*, *S 23439*, *S 43732*, *S 48195*, and *S 52397*). Also occurring in Kalimantan (e.g., *Teijsmann 7910*).

Ecology. In lowland and lower montane forests at altitudes to 1500 m.

Uses. The latex from the leaves can be applied to sores. Infusions from all plant parts are used to treat syphilis. Also an ingredient of arrow poison.

3. **Tabernaemontana macrocarpa** Jack Fig. 9.

(Greek, *makro* = large, *karpos* = fruit; with large fruit)

Mal. Misc. 2, 7 (1882) 80; Merrill *op. cit.* (1921) 498; Masamune *op. cit.* 624; Anderson *op. cit.* 149; Ashton *op. cit.* 45; Leuuwenberg *op. cit.* (1991) 165; Turner *op. cit.* 129; Coode *et al.* (eds.) *op. cit.* 28; Argent *et al.* (eds.) *op. cit.* 83; Middleton *op. cit.* 32; PROSEA *op. cit.* 535; Beaman *et al. op. cit.* 112. **Neotype** (Leuuwenberg, 1991)**:** *W.J. de Wilde 14396*, Sumatra, Ketambe, Lau Alas Valley (holoneotype L; isoneotypes BO, K, KEP, US, Z). **Synonyms:** *Pagiantha macrocarpa* (Jack) Markgr., *op. cit.* 546; *Ervatamia macrocarpa* (Jack) Merr., J. Arn. Arb. 33 (1952) 246.

Shrub or tree to 30 m tall, to 50 cm diameter, with low buttresses. **Bark** yellowish brown, brown, grey-brown or grey, finely fissured or with corky lenticels; inner bark pale cream. **Sapwood** pinkish cream to white. **Twigs** glabrous, lenticellate. **Leaves** *mostly thickly coriaceous*, glabrous; blade elliptic, 10–41 × 1.9–22 cm, 2–6.2 times as long as wide, base cuneate, *apex apiculate or rounded*, *rarely acuminate*; *lateral veins 9–22 pairs*, *more or less straight*; intercostal venation mostly obscure; petiole 10–40 mm long. **Inflorescences** few- to many-flowered, 7–20 cm long, glabrous. **Flowers** fragrant; pedicels 10–45 mm long; *sepals 3–6 × 3–5 mm*, ovate or suborbicular, apex rounded, ciliate, otherwise glabrous or with a few hairs outside; corolla with various combinations of cream, white and orange, in mature bud 1.5–3.1 cm long with ovoid to subglobose head 0.25–0.4× the length of bud,

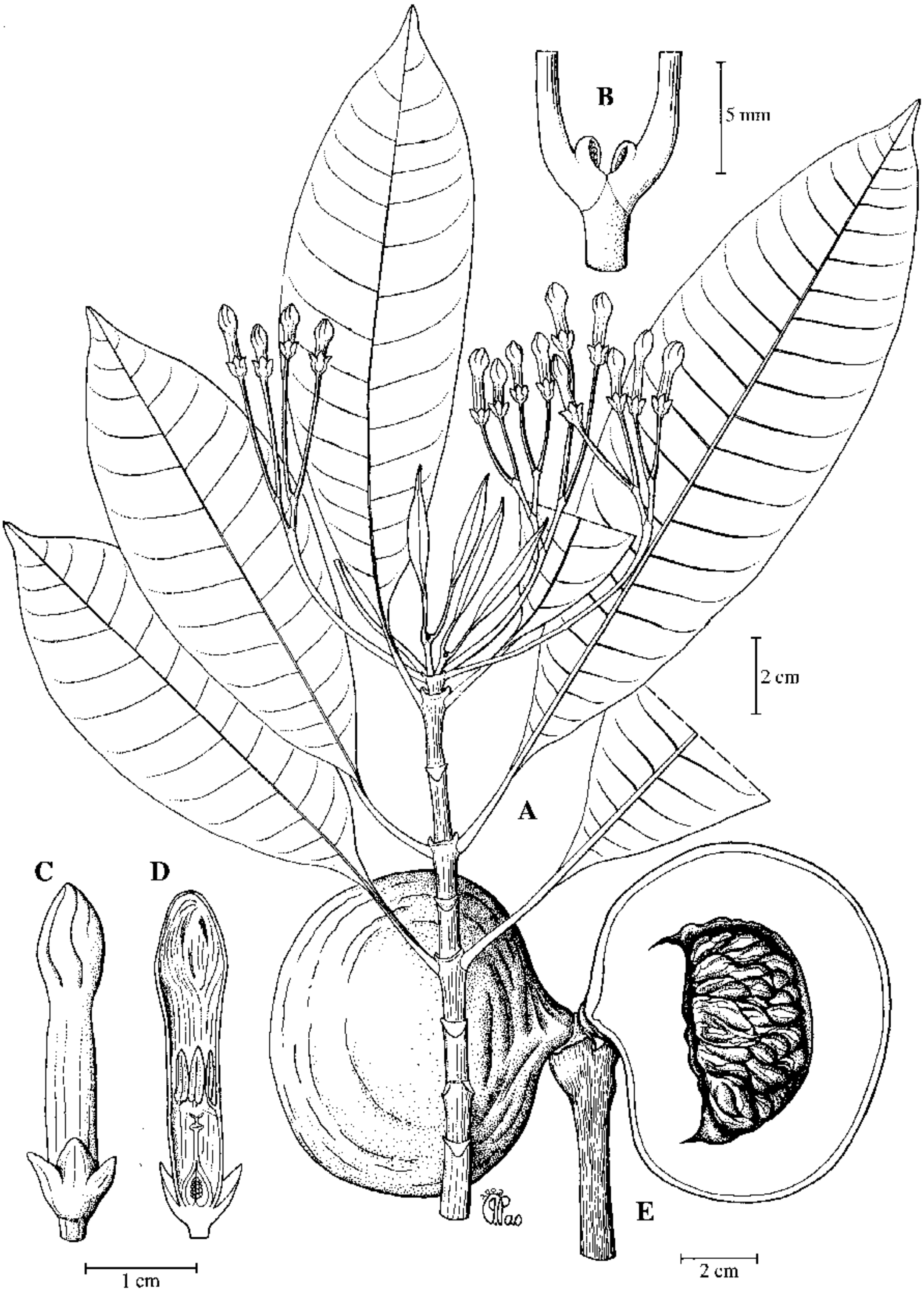

Fig. 9. *Tabernaemontana macrocarpa.* A, flowering leafy twig; B, intrapetiolar ocrea; C, flower bud; D, longitudinal section of flower bud; E, fruits. (A–D from *S 23620*, E from *Hansen 1110*.)

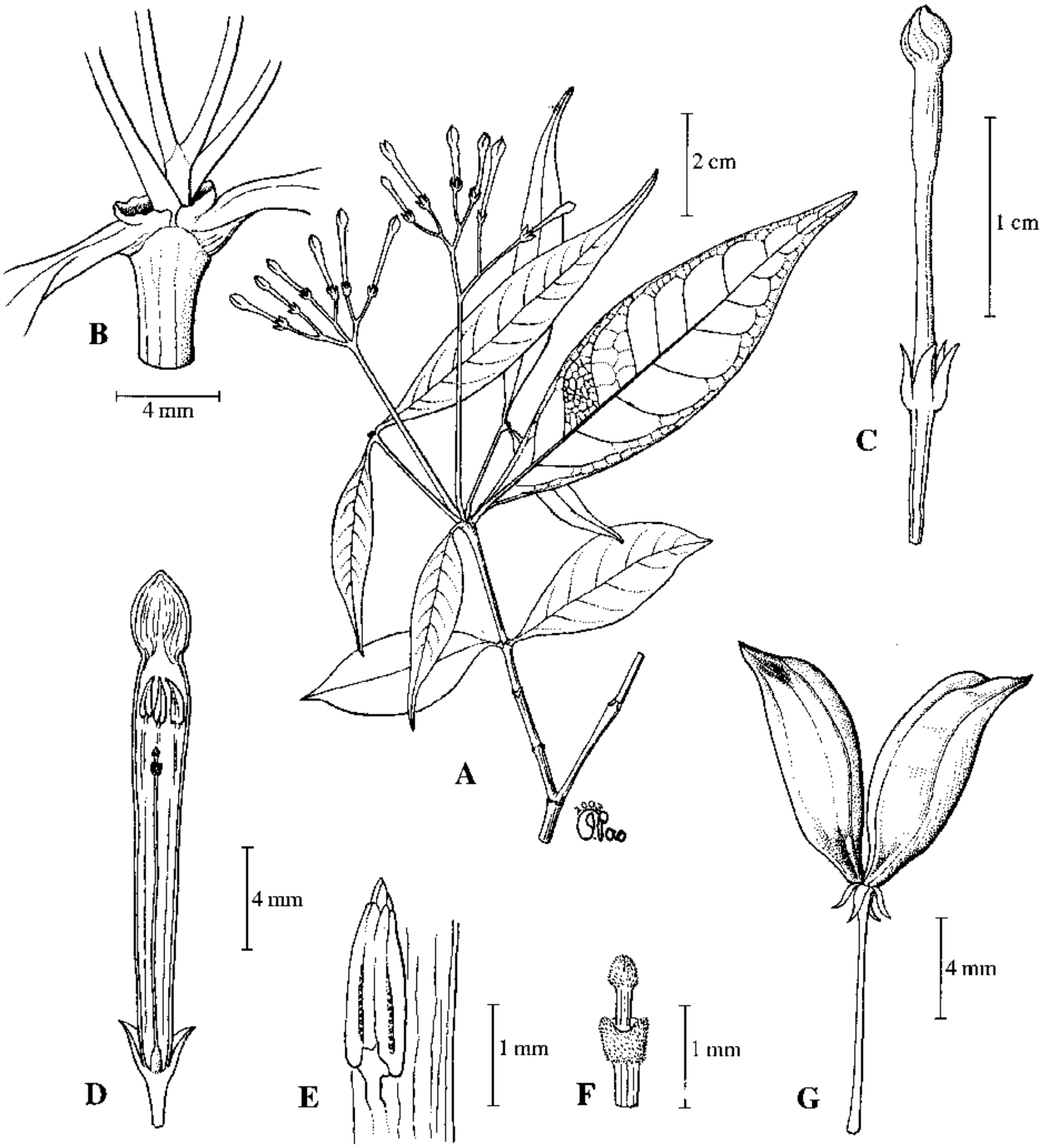

Fig. 10. *Tabernaemontana pauciflora.* A, flowering leafy twig; B, intrapetiolar ocrea; C, flower bud; D, longitudinal section of flower bud; E, stamen; F, upper part of style head; G, fruits. (A–F from *SAN 80500*, G from *S 31146*.)

apex acute to rounded, tube 10–21 mm long, lobes 14–31 × 7–15 mm, apex rounded; stamens inserted at 4–9 mm from the base of corolla tube, anthers 2.3–3.5 × 1–1.4 mm; ovary glabrous, 2.5–4 mm long, style 1.7–4.5 mm long; pistil head 0.7–2.5 mm long. **Fruits** of 2 follicles, separate or joined at base, orange, *8–16 × 5–16 cm*, sometimes with faint ridges, many-seeded. **Seeds** with a red aril.

Vernacular names. Sabah—*burut-burut* (preferred name), *lampada* (Dusun, Ranau). Sarawak—*peler kambing* (Brunei Iban), *tara manang* (Iban).

Distribution. S Thailand, Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Borneo, widespread in Sabah (e.g., *SAN 32011*, *SAN 82449*, *SAN 83889*, *SAN 127116*, and *SAN 127377*) and Sarawak (*S 43693*, *S 44875*, *S 49148*, *S 49679*, and *S 49680*). Also occurring in Brunei (e.g., *BRUN 1057* and *BRUN 3122*) and Kalimantan (e.g., *Kostermans 4952*, *Kostermans 21187*, *Leeuwenberg 13027*, and *Ridsdale PBU 551*).

Ecology. Common in primary and secondary lowland and lower montane forests on sandy loam soils, at altitudes to 1500 m.

Uses. Fruit used to alleviate toothache; the chopped root is an ingredient of arrow poison.

4. **Tabernaemontana pandacaqui** Poir.

(of Pandacaqui in the Philippines)

In Lam., Encycl. 7 (1806) 529; Merrill, Enum. Philip. Fl. Pl. 3 (1923) 325; Leeuwenberg *op. cit.* (1991) 169; Middleton *op. cit.* 33; PROSEA *op. cit.* 535. **Type:** *Sonnerat s.n.*, the Philippines, Luzon, near Manila (holotype P-LA; isotype P). **Synonyms:** *Tabernaemontana orientalis* R.Br., Prodr. (1810) 468, Merrill *op. cit.* (1921) 499, Masamune *op. cit.* 624; *T. floribunda* Blume, Bijdr. Fl. Ned. Ind. (1826) 1028, Backer & Bakhuizen *f. op. cit.* 229, Anderson *op. cit.* 149, Ashton *op. cit.* 43. (For further synonymy, *cf.* Leeuwenberg *op. cit.* (1991) 169).

Shrub or small tree to 14 m tall. **Twigs** lenticellate, occasionally sparsely pubescent. **Leaves** *papery or subcoriaceous*, glabrous or pubescent; blade elliptic or obovate, 3–14.1(–25) × 1–6.5(–10) cm, base cuneate, *apex acuminate or caudate*; *lateral veins 4–14 pairs*, *curved-ascending*, weakly anastomosing near margin, *frequently much paler than the blade above*; intercostal venation mostly reticulate, sometimes obscure, often paler than the blade; petiole 3–20 mm long. **Inflorescences** pubescent or glabrous, 4–11 cm long, 2–many-flowered. **Flowers** weakly or not scented; *sepals ovate*, *1–4 × 0.5–2 mm*, apex rounded to acuminate, pubescent or glabrous, *ciliate or not ciliate*; *corolla never doubled*, white or pale yellow, in mature bud (1–)2.2–3 cm long with globose head 0.2–0.4× the length of bud, *apex rounded or obtuse*, glabrous on both sides, rarely pubescent at base of lobes or in throat, *tube* (*8–*)*18–23 mm long*, twisted or not, *lobes not ciliate*, (6–)15–17 × 2–10 mm; *stamens inserted at 5–14 mm from the base of corolla tube*, anthers 1.1–5 × 0.4–1 mm; ovary 1–2.8 mm long, style and pistil head 1.1–1.6 mm long. **Fruits** of 2 separate follicles, orange, red or yellow, obliquely ellipsoid, *0.9–7.1 × 0.5–3 cm*, apex acuminate, slightly reflexed, distinctly longitudinally ridged, glabrous or pubescent, *1–40-seeded*. **Seeds** with a red or orange aril.

Distribution. S China, Taiwan, Thailand, Borneo, eastern parts of Indonesia, northern parts of Australia, and western Pacific. In Borneo, only known from Sabah, scattered in islands in Kota Belud, Kudat, Lahad Datu and Lamag districts (e.g., *SAN 22154*, *SAN 110071*, *SAN 125369*, *SAN 129417*, and *SAN 135370*).

Ecology. Found in a wide variety of habitats, particularly in drier areas.

Uses. Used in a bath after childbirth and is applied to bruises, wounds and swellings.

5. **Tabernaemontana pauciflora** Blume Fig. 10, Plate1F.

(Latin *pauci-* = few; *florus* = flower; few-flowered)

Bijdr. Fl. Ned. Ind. (1826) 1028; Merrill *op. cit.* (1921) 499; Masamune *op. cit.* 624; Leeuwenberg *op. cit.* (1991) 182; Turner *op. cit.* 130; Coode *et al.* (eds.) *op. cit.* 28; Middleton *op. cit.* 33; PROSEA *op. cit.* 536; Beaman *et al. op. cit.* 112. **Type:** *Blume 73*, Java, near Rompien (holotype L). **Synonyms:** *Tabernaemontana malaccensis* Hook.*f.*, *op. cit.* 649, Corner *op. cit.* 161; *Ervatamia malaccensis* (Hook.*f.*) King & Gamble *op. cit.* 452, Ridley *op. cit.* (1923) 343; *T. polysperma* Merr., Philip. J. Sci. 21 (1922) 531, Merrill, PEB (1929) 254, Masamune *op. cit.* 624. (For further synonymy, *cf.* Leeuwenberg *op. cit.* (1991) 182).

Shrub or small tree to 6 m high, to 10 cm diameter. **Bark** pale grey to grey-brown, smooth; inner bark pale yellow. **Sapwood** pale yellow. **Twigs** glabrous, with few lenticels. **Leaves** *papery*, glabrous; blade narrowly elliptic or elliptic, 3–26 × 0.6–10 cm, base cuneate, *apex acuminate or caudate*; *lateral veins 5–20 pairs*, *curved-ascending*, *concolourous or slightly paler than the blade*; intercostal venation obscure; petiole 2–7 mm long. **Inflorescences** 3–15-flowered, 2–10 cm long, glabrous to minutely puberulent. **Flowers** fragrant; pedicels 3–10 mm long; *sepals ovate to oblong*, *2–4 × 0.7–1.2 mm*, *not ciliate*, apex acuminate to acute, glabrous to sparsely puberulent; *corolla never doubled*, white, sometimes yellow in the throat, in mature bud 1.4–3.8 cm long with ovoid head 0.2–0.33× the length of bud, *apex acuminate to obtuse*, *tube 12.5–23 mm long*, *lobes not ciliate*, 7–14 × 3–9 mm, apex rounded, glabrous inside; *stamens inserted at 9–16 mm from the base of corolla*; anthers 1.5–4 × 0.5–1 mm; ovary glabrous, 0.6–2 mm long, style 8.5–15 mm long; pistil head 0.7–1.2 mm long. **Fruits** of 2 separate follicles, yellow or orange, *2–6 × 0.7–2 cm*, with 1 or 2 clear lateral ridges on each side, *many-seeded*. **Seeds** with a red aril.

Vernacular names. Sabah—*lampada* (Dusun, Ranau), *berancang asu* (Dusun).

Distribution. Myanmar, Thailand, Cambodia, Vietnam, Sumatra, Peninsular Malaysia, Singapore, Java, and Borneo. In Borneo, common in Sabah (e.g., *SAN 81998*, *SAN 86598*, *SAN 86860*, *SAN 118758*, and *SAN 126270*) but scattered in the eastern parts of Sarawak (e.g., *S 30683*, *S 31146*, *S 31922*, *S 52315*, and *S 65633*). Also occurring in Brunei (e.g., *Bernstein 236*, *Cowley 108* and *Wong WKM 1161*) and in Kalimantan (e.g., *Kostermans 10577A*, *Kostermans 21671* and *Leeuwenberg & Rudjiman 13026*).

Uses. As in *T. pandacaqui*.

Note. The specific limit between *T. pauciflora* and *T. rostrata* are not entirely clear. Further research may reveal that specimens with long narrow calyx lobes, which have been assigned to *T. pauciflora* by Leeuwenberg (*op. cit.* 1991) and also in this work, might have to be transferred to a more broadly defined *T. rostrata*.

9. **VOACANGA** Thouars

(Latinisation of a Malagasi plant name)

Gen. Nov. Madag. (1810) 10; Backer & Bakhuizen *f.*, FJ 2 (1965) 229; Anderson, CLTS (1980) 150; Leeuwenberg, Agric. Univ. Wag. Pap. 85-3 (1985) 9; Ashton, MNDTS 2 (1988) 45; PROSEA 12, 2 (2001) 582.

Shrubs or trees with dichotomous branching; with white latex. **Leaves** *opposite*, with small stipule-like flaps in the axils, sometimes obscure. **Inflorescences** cymose or flowers solitary, lax; 2 inflorescences at each ramification. **Flowers** usually fragrant; *sepals in most species with a distinct connate tube and free lobes*, usually with glands inside, shed with the corolla; corolla lobes overlapping to the left in bud, mature corolla with narrow or trumpet-shaped tube and spreading lobes; stamens subsessile, completely included in the corolla tube or slightly exserted, anthers narrowly triangular, base sagittate, apex acuminate, sterile at apex, weakly attached to the pistil head; disc adnate to sides of carpels; ovary of two separate carpels united into a common style, style filiform; pistil head short. **Fruits** of paired follicles, usually somewhat united at least at the base. **Seeds** *covered in a fleshy aril.*

Distribution. About 12 species, distributed in Africa and Malesia. Two species occur in Sabah and Sarawak.

Ecology. Mostly in wet aseasonal or seasonal lowland evergreen forests.

Key to *Voacanga* species

Leaves glabrous below; corolla tube more than 20 mm long……………………**1. V. foetida**

Leaves pubescent below; corolla tube less than 15 mm long……………..…**2. V. havilandii**

1. **Voacanga foetida** (Blume) Rolfe

(Latin, *foetidus* = evil-smelling; the flowers)

J. Bot. London 21 (1883) 202; Backer & Bakhuizen *f. op. cit.* 229; Leeuwenberg *op. cit.* 47; PROSEA *op. cit.* 584. **Basionym:** *Orchipeda foetida* Blume, Bijdr. Fl. Ned. Ind. (1826) 1027. **Type:** *Blume s.n.* (= *RHL Sheet No. 898112361*), Java, without locality (holotype L; isotypes MEL, P, U).

Tree to 20 m tall, to 40 cm diameter. **Bark** grey, whitish brown, or grey-brown, smooth; inner bark medium yellow-brown, fibrous. **Sapwood** pale yellow. **Twigs** glabrous, lenticellate. **Leaves** papery, *glabrous*; blade elliptic, obovate or ovate, 7–37 × 3–11 cm, base cuneate, apex acuminate or apiculate; lateral veins 7–15(–17) pairs, curved-ascending; intercostal venation scalariform or inconspicuous; petiole 5–9(–15) mm long. **Inflorescences** few-flowered, 12–22 cm long, glabrous; peduncles 5–15 cm long. **Flowers** with an unpleasant smell; pedicels (1–)2.5–4 cm long; calyx forming a campanulate tube, slightly fleshy, glabrous outside, tube 12–28 mm long, lobes 4–12 × 5–11 mm, apex rounded; corolla white, *tube 28–45 mm long*, widening towards apex, glabrous on both sides, lobes 37–95 × 22–44 mm, apex rounded, glabrous; stamens inserted near the base of the corolla tube; disc annular, *c.* 0.5 mm high; ovary glabrous, *c.* 2 mm high, style short.

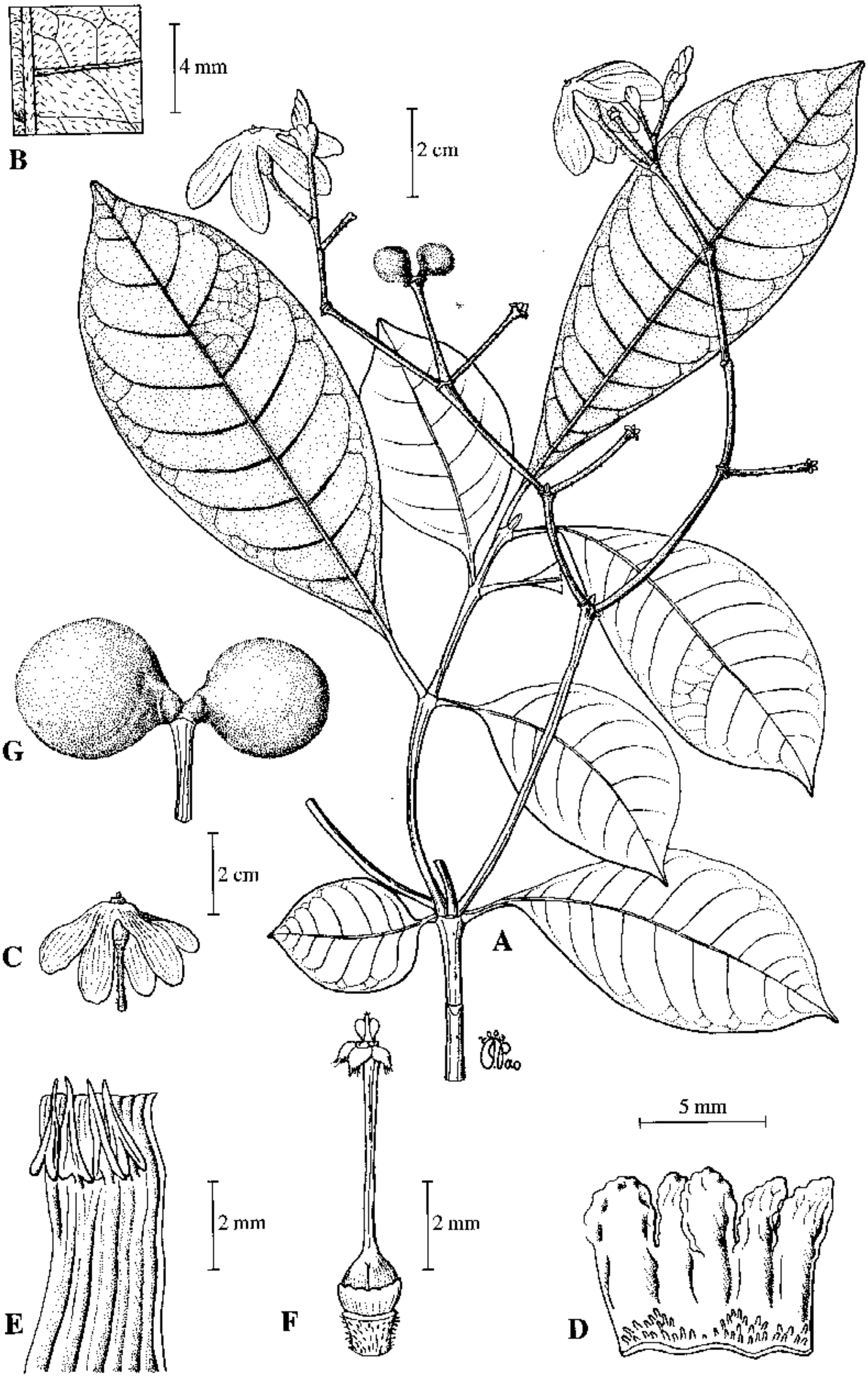

Fig. 11. *Voacanga havilandii*. A, flowering and fruiting leafy twig; B, detail of venation and indumentum on lower leaf surface; C, open flower; D, adaxial view of calyx showing colleters; E, stamens; F, gynoecium; G, fruits. (A–B from *S 29303*, C–F from *S 18456*, G from *S 65623*.)

Fruits fleshy, free from each other, subglobose, 6–11 cm diameter. **Seeds** with an orange aril.

Distribution. Sumatra, Borneo, and Java. In Borneo, known from Sandakan district in Sabah (e.g., *Wong WKM 2653*) and in Kalimantan (e.g., *Dachlan 2149*).

Ecology. In forest at altitudes to 600 m.

Uses. Latex can be applied externally against skin diseases.

2. **Voacanga havilandii** Ridl. Fig. 11.

(G.D. Haviland, 1857–1901, First Sarawak Medical Officer, plant and insect collector)

Bull. Misc. Inform. Kew (1926) 473; Masamune, EPB (1942) 625; Anderson *op. cit.* 150; Leeuwenberg *op. cit.* 63; Ashton *op. cit.* 46. **Type:** *Haviland 593*, Borneo, Sarawak, Kuching (holotype K; isotype SAR). **Synonym:** *Voacanga borneensis* Markg., Mitt. Bot. Staatssamml. München 1 (1950) 28.

Small tree to 15 m tall, to 15 cm diameter. **Bark** pale green to whitish, lenticellate. **Twigs** pale grey-brown with a few large lenticels, glabrous. **Leaves** *pubescent below*, thinly coriaceous; blade elliptic to obovate, 3.7–25 × 1.7–9.5 cm, 1.3–4.1 times as long as wide, base cuneate, apex acuminate to apiculate; lateral veins 7–14 pairs, almost perpendicular to the midrib, anastomosing into a looped intramarginal vein; petiole 4–25 mm long. **Inflorescences** lax, many-flowered, to 35 cm long, glabrous to pubescent; peduncles 4.5–16 cm long. **Flowers:** pedicels 1–2.4 cm long; calyx 6–12 mm long, tube campanulate, 3–9.5 mm long, glabrous to sparsely pubescent; corolla white or cream, *tube 7–11 mm long*, cylindrical, somewhat wider around the anthers, lobes 15–24 × 7–11 mm, apex rounded, spreading or recurved; stamens inserted in the upper part of corolla tube, anther apex near corolla mouth; disc annular, crenate, 0.4–0.8 mm high; ovary 1–2 mm high, glabrous. **Fruits** subglobose, 3.5–5 cm diameter. **Seeds** with an orange-red aril.

Vernacular name. Sarawak—*bardal* (Iban).

Distribution. Endemic in Borneo. In Sarawak, scattered (e.g., *S 18456*, *S 19475*, *S 29303*, *S 39934*, and *S 64345*) but not yet known from Sabah. Also occurring in Kalimantan (e.g., *Burley et al. 2826*).

Ecology. In lowland mixed dipterocarp forest at altitudes to 200 m.

DIPTEROCARPACEAE

P.S. Ashton

Arnold Arboretum, Harvard University Herbaria, Cambridge, Massachusetts, U.S.A. and
Royal Botanic Gardens, Kew, England, U.K.

Blume, Bijdr. Fl. Ned. Ind. (1825) 223; F. Heim, Rech. Dipt. (1892) 1; King, J. As. Soc. Beng. 62, 2 (1893) 87; Brandis, J. Linn. Soc. Bot. 31 (1895) 1; Merrill, EB (1921) 397; Ridley, FMP 1 (1922) 209; Gilg *in* Engler & Prantl, Nat. Pflanzenfam. edition 2, 21 (1925) 237; Foxworthy, Philip. J. Sci. 6 (1911) Bot. 231, Philip. J. Sci. 13 (1918) Bot. 163, Malay. For. Rec. 10 (1932) 4, Philip. J. Sci. 67 (1938) 241; Masamune, EPB (1942) 482; Symington, Malay. For. Rec. 16 (1943) 1; Brown, FTSB (1955) 88; Backer & Bakhuizen *f.*, FJ 1 (1964) 328; Ashton, MDB (1964) 1, MDBS (1968) 1, FM 1, 9 (1982) 237, *in* Kubitzki *et al.* (eds.), Fam. Gen. Fl. Pl. 5 (2000) 182; Meijer & Wood, Sabah For. Rec. 5 (1964) 9; Burgess, TBS (1966) 93; Anderson, CLTS (1980) 110; Kessler & Sidiyasa, TBSA-EK (1994) 86; Coode *et al*. (eds.), CLBD (1996) 66; Newman *et al.*, MDFB-LHW (1996) 55, MDFB-MHHW (1998) 57.

Mostly large canopy or emergent, *resinous trees*; usually buttressed. **Bark** smooth, fissured or flaky. *Indumentum comprising fascicled hairs*, sometimes also simple hairs, unicellular or multicellular glandular hairs or short- or long-lobed peltate scales. Shoot growth rhythmic. **Twigs** with small or large, sometimes species-specific (*Dipterocarpus*), shoot-buds. **Stipules** species-specific in some taxa (especially in *Dipterocarpus*), *generally caducous leaving distinct scars*. **Leaves** alternate; blade simple, generally penninerved, *base generally terminating abruptly at the frequently geniculate petiole*, margin entire though sometimes sinuate, often narrowly revolute, apex generally acuminate; lateral veins very slender (densely parallel in *Cotylelobium*, *Dryobalanops* and some *Hopea*), *often with axillary domatia*; intercostal venation scalariform or reticulate. **Inflorescences** *generally paniculate*, sometimes racemose or rarely subcymose, terminal, axillary or sometimes ramiflorous, furnished with paired modified stipules at nodes, generally regularly 1–2(–3)-branched, the branchlets bearing distichous or secund flowers. **Flowers** bisexual, radially symmetrical, scented, nodding; calyx persistent, 5-merous, *sepals free and quincuncial-imbricate* or united at base with valvate lobes, *with 2–3*(*–5*) (outer if imbricate) *lobes enclosing those remaining and generally greatly expanding and spatulate and lightly twisted in fruit*; corolla 5-merous, *petals contorted*, weakly connate at base or free, *almost always partially unicellular-hairy outside*; stamens 5 to more than 100, 1–3-verticillate or irregular, hypogynous or subperigynous, centrifugal, *filaments generally compressed at base*, *tapering and filiform distally*, or filiform throughout, frequently connate to petals, anthers erect, 2-loculed with (2–)4 pollen sacs, introrse or latrorse, *connective with more or less prominent appendage*, variously short or long, aristate or stout, erect or reflexed; *ovary generally superior*, sometimes semi-inferior, (2–)3(–5)-loculed, style generally columnar, often thickened at base into a stylopodium, stigma generally obscure, more or less distinctly trifid; ovules 2(–many) per locule, axile, pendulous or laterally anatropous, bitegmatic with ventral raphe and superior micropyle. **Fruits** indehiscent *1*(*–many*)*-seeded nuts with woody pericarp and persistent calyx appressed to the base*; *calyx lobes more or less expanding into spatulate wings*; *cotyledons generally fleshy*, sometimes laminar, entire or variously lobed, *frequently unequal*, *one more or less enclosing the other*, *both enclosing the radicle.* **Germination** epigeal or hypogeal, the pericarp splitting loculicidally or irregularly.

Distribution. Pantropical, with about 500 species in 3 subfamilies and 17 genera. In Sabah and Sarawak the family is represented by 9 genera with 267 species.

Ecology. In Sabah and Sarawak, occurring especially in mixed and upper dipterocarp forests but also in other non-saline habitats, at altitudes to 1800 m. Rare in secondary forest following clearing.

Notes. The resinous smell of fresh wood and bark, the twig with stipular scars, and the stipulate leaf with simple entire-margined blade terminating abruptly at the frequently geniculate petiole, serves to distinguish a dipterocarp at any stage in the field.

The Dipterocarpaceae have been regarded as allied to Guttiferae, Theaceae and Order Malvales, especially the Tiliaceae. Ashton (1982) considered the family to be allied to Sarcolaenaceae and Tiliaceae, and to be within Order Malvales. Molecular evidence (Alverson *et al.*, Am. J. Bot. 85 (1998) 876) indicates Dipterocarpaceae to share a clade allied to but not within core Malvales, with Sarcolaenaceae (trees of Madagascar and formerly Africa) and Cistaceae which are temperate shrubs. Molecular evidence (Alverson *et al.*, *op. cit.*; Dayanandan *et al.*, Am. J. Bot. 86 (1999) 1182) supports the close affinity of the three putative subfamilies of the Dipterocarpaceae.

Maguire & Ashton (Taxon 26 (1977) 341) subdivided the Dipterocarpaceae into three subfamilies, which can be distinguished as follows:

1. Anthers basifixed; sepals, if amplicate, then generally conspicuously unequal with 2–3 becoming wing-like in fruit; ovary (2–)3-loculed, each locule with 2 ovules. Wood, leaves and ovary with resin or secretory ducts; wood-rays multiseriate. Tropical Asia and Malesia.……subfam. **Dipterocarpoideae**
   Anthers basi-versatile; sepals equally accrescent, papyraceous; ovary (2–)3–4(–5)-loculed, each locule with 2–4 ovules. Wood, ovary and, commonly, leaves without resin or secretory ducts……2

2. Petals longer than sepals; anthers little or deeply basi-versatile, connective little or moderately projected as an apical appendage; ovary 3(–5)-loculed, each locule with 2 ovules. Wood-rays predominantly uniseriate. Tropical Africa and Madagascar………… subfam. **Monotoideae**
   Petals shorter than sepals; anthers deeply basi-versatile, connective conspicuously projected as an apical appendage; ovary 4(–5)-loculed, each locule with 4 ovules. Wood-rays predominantly biseriate. Tropical America………subfam. **Pakaraimoideae**

Phytogeography. The subfam. Dipterocarpoideae comprise 13 genera, with *c.* 475 species, confined to the Asian tropics between the Seychelles Is. and S Asia to New Guinea but absent in the Lesser Sunda Is. east of Sumbawa. Most genera and species occur in the W Malesia: Sumatra, Peninsular Malaysia, Singapore, Java, Borneo, the Philippines and islands in between. Sabah and Sarawak, which have 267 species in 9 genera, is the richest area in the world for dipterocarp species.

Within NW Borneo, dipterocarps manifest rather distinct geographical provinces, partially irrespective of the geographical range of their specific habitats. One distinct province is north of a line from Pontianak following the Sg. Kapuas to the Kapuas Lakes in Kalimantan, then across the Sarawak lowlands to Sipitang District in SW Sabah, with a few entities occurring north to Papar. Species confined to this province, yet not endemic in Borneo, indicate this province to be the Borneo extension of Corner's Riau Pocket. Within it, there is a distinct barrier at the Lupar valley, including several Peninsular Malaysian/Sumatran elements west of it, as well as some endemics. It is noteworthy that the boundary of this province coincides with the extent of major areas of peat swamp, *kerangas*, and mixed dipterocarp forest on deep yellow humult sandy soils; several of these soils specialists extend to E Sabah, mainly on ultrabasic substrates. A second mainly lowland province occurs from Sandakan district in E Sabah southwards, with no distinct southern boundary but gradual attrition of species southwards to Balikpapan and beyond though many only reach Tidung and Berau in NE Kalimantan. This province includes some Philippine species, some of which extend westwards to NE Sarawak and Brunei. Most species confined to Borneo to this province occur in mixed dipterocarp forest on clay soils. A third province, overlapping with the other two, contains species of the central Borneo uplands. Those species of low altitudes are centred, in Malesia, around the Rajang hinterland, extending across to Ulu Barito, Kayan, and sometimes the poorly explored Kapuas hinterland. Those of the upper dipterocarp forest are mostly as yet unrecorded from Kalimantan and there is increasing endemism towards the northeast, peaking around Mt. Kinabalu.

We have relied, for our distribution and ecological records, in this account on the extensive data cited in the unpublished report of Brunig (1966)* the identifications for which I was responsible; Anderson's (1963) Checklist for the peat swamps, and my own data from 105 sample plots, and the 52 ha plot in Lambir Hills NP. In mixed dipterocarp from Miri to Kuching districts.

Ecology. Members of the subfamily Dipterocarpoideae are overwhelmingly concentrated in aseasonally wet lowland evergreen forests on well-drained soils, at altitudes below 800 m and with declining numbers above 400 m. There, the subfamily is characterised by supra-annual mass flowering especially among canopy species, mast fruiting synchronised at subfamily level, and high survival of germinants: forests most dense in dipterocarp species have abundant saplings at all times. Dipterocarp species are either late successional, their juveniles with relatively high growth rates and low shade tolerance; or climax, their juveniles having relatively low maximum growth rates but high shade tolerance. Dipterocarps are most rich in species in forests with high canopy heterogeneity imparted by frequent small to moderate-not large-gap formation. Dipterocarps are ectotrophic mycorrhizal: they are most species-rich on yellow soils with shallow acid raw humus, and their juveniles are easily eliminated by soil surface disturbance; dipterocarps return to abandoned *ladang* slowly, in part owing to their limited dispersal; but they may not return for centuries on humic soils whose surface has been removed or destroyed by machinery, burning or cultivation. Nevertheless, the fast growth rates and superior timber quality of many species, combined with their abundant regeneration, makes them the easiest major rain forest timber family, world-wide, to be sustainably managed for timber. Most dipterocarps are highly habitat specific: local conservation planning for dipterocarp species must first conserve adequate area of each of the main habitats in which they occur.

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*Brunig, E.F. 1966. Der Heidewald von Sarawak und Brunei—eine Studie seiner Vegetation und Ökologie. 2 Beschreibung der Arten. Pp. 41–73.

Particularly, species are generally highly soil-specific, and appropriate choice of species is essential for plantation. Many species appear to be able to occur, occasionally, to the altitudinal limits of lowland tropical soils, which is generally at 700–1200 m altitude; those that are confined to low altitudes appear to be on soils similarly constrained. The subfamily as a whole reaches its highest biomass, and stand density on yellow and red lowland soils, where the major division in forest species composition correlates with the presence or absence of surface acid raw humus. On these yellow/red soils, dipterocarps comprise more than half the above-ground tree biomass, and more than 70% of the emergent individuals; they are less well represented by species which reach maturity in the main canopy or subcanopy though these 'mixed dipterocarp forests' support many juvenile dipterocarps of all sizes, especially saplings. In this treatment, commonness is estimated in relation to ecology, for forest prior to logging.

Dipterocarps are insect pollinated; species within each major taxon share the same insect pollinators. Flowering within a major taxon, especially in the sections of *Shorea*, is sequential within one habitat and species association, with overlap in flowering between successive species. Dipterocarps are self-compatible, though available evidence suggests that outcrossing is high in nature, and that progeny from outcrossing have higher survivorship than those originating from selfing. Apomixis through adventive embryony appears to be important in some species. Dipterocarp seeds lack dormancy, the species populations therefore being dependant on an abundant population of juveniles. Fruits are primarily dispersed by gyration occasioned by the twisted wing-like fruit sepals, though many appear to have no means of dispersal. Terrestrial mammals, especially rodents, may inadvertently disperse seed for short distances, and scatter-hoarding occurs. A few species are water-dispersed. Fruit dispersal is, therefore, mostly very limited in the aseasonal wet tropics except during exceptional wind storms. Dipterocarps may take centuries, or longer, to disperse back into extensive cleared areas.

Dipterocarps are, generally, a poor source of food for larger animals; their resinous parts are astringent with tannin and difficult to digest, while the lipid-rich fruits are only produced at long intervals when their superabundance far exceeds the capacity of animals to consume them; this thereby permits their copious regeneration. Supra-annual mast fruiting appears to explain both the success of dipterocarps in western Malesia, and the relatively low animal carrying capacity of vertebrates there compared with evergreen lowland tropical forests in Africa and America. Recently, it has been discovered that wild pigs (*Sus scrofa*) in Pasoh FR, Peninsular Malaysia, preferentially harvest dipterocarp saplings to build their nests; the increase in food availability for pigs, provided by fallen fruit in oil palm plantations adjacent to mixed dipterocarp forest, is thereby leading to dramatic declines in dipterocarp saplings, and may lead to a declining role of the subfamily at least near the edge of the forest.

Uses. Dipterocarps have had a wealth of traditional uses (PROSEA 5, 1 (1993) 94, 139, 166, 186, 238, 299, 325, 384, 458 & 461), few of which have survived rural economic change.

The earliest recorded use was for camphor, from *Dryobalanops aromatica*, which was exported in medaeval times to the Middle East, where it has been said it was worth its weight in gold as a base for incense. Iban girls formerly used camphor resin in a similar way, melting the camphor then infusing it with other scents; it was then used as a solid perfume and hidden in their pillows. There would appear to be opportunities for commercial development of this attractive fashion for a wider market.

The viscid resin of *Dipterocarpus* was used, eventually commercially, as a basis for paints and for caulking wooden boats, particularly in seasonal continental Asia where several species produce copious resin and are tapped with the aid of fire. This practise continues in the poorer rural economies. The crystalline resin of some species of *Hopea*, known as *mata kucing*, was used as a base for medicines, and for varnishes. A charcoal, prepared from resin of *Shorea* sect. *Richetioides*, was formerly used for blackening teeth, a custom then among Lun Dayuh and Brunei women.

The abundance of astringent compounds in dipterocarp tissues, specifically the inner bark, was availed of as *laru*: macerated bark introduced to rice and coconut beer to arrest further fermentation; it was also used to prevent frothing during boiling of palm syrup during sugar manufacture.

The fat-rich cotyledons have formerly been an important source of famine food throughout Asia, and nuts of certain *Shorea* are still collected in Sri Lanka for preparation of sweetmeats, and in Borneo as a source of cooking fat with a high melting point. The large nuts of some species of *Shorea* sect. *Pachycarpae* and also sect. *Brachypterae*, sect. *Mutica* and sect. *Shorea* are particularly favoured, and are exported during mast years for use in chocolates, lipstick and other industrial products.

But since the early seventies, dipterocarps have provided the bulk of hardwoods traded on international markets; the light hardwood *Shorea* timbers being particularly in demand though the heavy hardwood *selangan batu* is marketed for decking, garden furniture and other purposes where a high quality weather resistant wood is required. Although timber harvesting can be managed sustainably (but almost certainly not also sustaining biodiversity), this has not been done because it involves additional costs and reduces profits. In particular, careless and inappropriate use of machinery, and especially re-entry for further logging while the residual stand is developing, has led to soils disturbance and damage to the original stand on such a scale that it is unlikely that economically merchantable stands of dipterocarps will return for at least one, and possibly several centuries. Although this practise is logical financially to the concession holder, it has economically impoverished the nation by degrading its most valuable sustainable resource.

By virtue of their commanding role in the structure of the lowland and hill forests of Sabah and Sarawak, dipterocarps possess unique economic service values, esthetically including for tourism, and in the conservation of the overall biodiversity of these ecosystems which are the most species-rich forests in the Old World, being matched only by some in the headwaters of the Amazon River. Their value in sequestration of atmospheric carbon is almost certainly greater than any other tropical plant family. The harvesting of the dipterocarp trees for timber dramatically affects the demography, hence interdependences, of the other plants and animals of the forest, and extinctions can be predicted. This are major reasons why the forests of the national parks must remain sacrosanct.

Conservation status. I have endeavoured, on available evidence and personal experience, to predict the degree of endangerment of the dipterocarp species in our region. My criteria require explanation. The International Union for the Conservation of Nature (IUCN) has drawn up criteria for making standard comparable assessments of conservation status for organisms in general, plants as well as animals. Their criteria are based, however, mainly on animal population characteristics. Most animals are less physical-habitat-specific than plants, and their populations therefore generally extend more continuously over large areas. Animals also have shorter life-spans than trees. IUCN has placed high emphasis, therefore, on the amount by which habitat has been reduced in area over the last three generations of a species. Were this criterion literally applied to dipterocarps, all our species would be judged to be at some level of endangerment!. Dipterocarp populations, by being highly habitat-specific, are already often fragmented in nature into an archipelago of habitat-islands. It is, therefore, the number of these islands that survive forest harvesting or conversion that matters to them, rather than the absolute decline in primary (or logged) forest area. A further important rule of thumb, which can reasonably applied to both plants and animals, is the minimum acceptable size of populations of mature reproductive individuals that is needed to sustain the genetic diversity found in nature through outbreeding. It is generally assumed that a minimum of 200 mature individuals, in a given area/habitat, is needed, that is a minimum of 200 within the foraging range of the pollinating insect in the dipterocarp case. It is thus obvious that logging has a major impact on the distribution and frequency of adequate dipterocarp breeding populations. It can reasonably be argued that the regeneration which survived from the primary forest through the logging process will in due course grow to become new populations of acceptable density. We hope that this may be the case, but fear that soil disturbance, uniformly low light conditions beneath the later regrowth, and the slow growth rates of climax species in relation to the length of the felling cycle, may all have adverse effects, particularly on the soil specialists and other less common species. I have therefore placed high emphasis on the accessibility and suitability of species' habitats for conversion to agriculture, and their occurrence in the national parks system, when assigning a level of threat to a species' survival within Sabah and Sarawak. The generally lower level of endangerement of species in Sabah and Sarawak when compared to their global distribution (*cf.* Oldfield *et al.* 1998. *The World List of Threatened Trees*, WCMC & IUCN) testifies largerly to their generally good conservation in the legislated Sabah and Sarawak park systems, which have been largerly protected from logging. In logged forests, surviving juveniles of the more light-demanding species may be expected to survive to maturity, as may those of understorey species; but the shade-tolerant, generally heavy hardwood species have an uncertain future there.

Key to genera

(based on flowering/fruiting specimens)

1. Fruit calyx lobes valvate, not incrassate, at base. Chromosome number x = 11 (tribe **Dipterocarpeae**)……………………………………………………………………………...…2
Fruit calyx lobes at least slightly imbricate at base (often becoming fully valvate in *Dryobalanops* and *Parashorea*), with a distinct incrassate expanded spoon-shaped base (united into a cup in *Dryobalanops*). Chromosome number x = 7 (tribe **Shoreae**)….…6

2. Base of fruit calyx united into a tube enclosing at least the basal half of the nut……..…3
Fruit sepals free to the base, or united into a shallow cup enclosing less than one third of the nut…………………………………………………………………………………...…4

3. Connectival appendage of stamen stout, tapering, at most 1½x the length of anthers. Nut free within calyx tube. Epidermis lacking peltate scales. Leaf bud prominent; stipules large, amplexicaul; leaf aestivation plicate; lateral veins not uniting into an intramarginal vein……………………………………………………….…**3. Dipterocarpus**
Connectival appendage of stamen slender, at least twice the length of anther. Nut adnate to calyx tube. Epidermis in part furnished with peltate scales. Leaf bud small;

stipules linear, with short scars; leaf aestivation not plicate; lateral veins joining distally into a prominent looped intramarginal vein……………………………**1. Anisoptera**

4. Stamens at least 25; connectival appendage at least twice the length of anther. Nut triangular in cross-section……………………………………………………**8. Upuna**
Stamens at most 15; connectival appendage at most 1½x the length of anther. Nut round in cross-section……………………………………………………………………5

5. Anthers linear-oblong, setose along lateral margins; style at least twice the length of ovary; stigma small, trifid. Leaf lateral veins densely parallel, unequal, slender and hardly raised, main veins joining distally uniting into a looped intramarginal vein…………………………………………………………………… **2. Cotylelobium**
Anthers broadly oblong to subglobose, glabrous; style less than twice the length of ovary; stigma conical, prominent. Leaf lateral veins well-spaced, usually distinctly raised below, with short or no intermediate veins, not or obscurely distally joined into an intramarginal vein………………………………………………………**9. Vatica**

6. Fruit calyx lobes all equal, all spatulate, wing-like, or all short. Leaf lateral veins very slender, dense, parallel, connected by a vein just within the margin…..**4. Dryobalanops**
Fruit calyx lobes unequal, spatulate (except in *Shorea isoptera*), or all short. Leaf lateral veins, if slender and dense, not joining into an intramarginal vein……………………7

7. Fruit calyx lobe base narrow, hardly imbricate; nut verrucose-lenticellate, ripening globose to ellipsoid………………………………………………………**6. Parashorea**
Fruit calyx lobe base broad, distinctly imbricate; nut not verrucose-lenticellate, ripening not so………………………………………………………………………………8

8. Flower calyx lobes with 2 outer ones thicker, more acuminate than the 3 inner ones, 2 becoming wing-like, spatulate in fruit, or all 5 short…………………………**5. Hopea**
Flower calyx lobes with 3 outer ones thicker, more prominently acuminate than the 2 inner ones, 3 becoming wing-like, spatulate in fruit or all 5 short……………**7. Shorea**

Field key to the genera and main field groups of *Hopea* and *Shorea*

1. Leaf lateral veins curving round towards the margin and anastomosing to form a distinctly looped intramarginal vein……………………………………………………2
Leaf lateral veins either without or with indistinct intramarginal vein, or intramarginal vein straight……………………………………………………………………………3

2. Bark surface remaining smooth at first, eventually irregularly flaky and becoming scroll-marked; inner bark homogeneous pale brown. Leaf intercostal venation obscure; main lateral veins very slender, hardly raised below, with many variably shorter intermediates; petiole not geniculate; leaf blade not lepidote below…...**2. Cotylelobium**
Bark surface vertically cracked, oblong-flaky; inner bark distinctly tangentially laminated. Leaf intercostal venation distinct, well-spaced, scalariform or reticulate; main lateral veins distinctly raised below; petiole geniculate; leaf blade peltate lepidote below……………………………………………………………………**1. Anisoptera**

3. Leaf lateral veins densely parallel, ending abruptly in a more or less straight intra-marginal vein close within margin…………………………………….…**4. Dryobalanops**
Leaf lateral veins pinnate or, if densely parallel, then not ending in intramarginal vein………………………………………………………………………………………4

4. Bark with large pale lenticels. Leaf lateral veins straight, hardly arched except towards the margin; leaf blade usually distinctly corrugated with distinct ridges between the lateral veins………………………………………………………………………...…5
Bark with small lenticels hardly paler than bark surface. Leaf lateral veins arched; leaf blade flat or bullate but not corrugated with distinct ridges…………………………..…6

5. Bark surface yellowish to orange- or rust-brown, rarely pinkish brown, becoming more or less irregularly flaky; lenticels scattered or in clusters, pale yellowish brown. Terminal (leaf) buds prominent; stipules large, scars amplexicaul; leaf blade coriaceous, never silvery below; petiole geniculate………………………………..…**3. Dipterocarpus**
Bark surface mauve- to dark purple- or tawny-brown, closely shallowly fissured and narrowly oblong-flaky; lenticels initially in vertical lines, eventually following the bottom of fissures and ridges of buttresses, whitish. Terminal buds and stipules generally small (except in *Parashorea macrophylla*), stipular scars short (except in *P. macrophylla* and *P. malaanonan*); leaf blade usually silvery below, particularly in juveniles…………………………………………………………………..…**6. Parashorea**

6. Lower leaf surface, twig, lateral veins and petiole densely whitish felty with brown tomentum; bark dark chocolate-brown, closely vertically cracked and flaky; buttresses stout, in groups…………………………………………………………………**8. Upuna**
Leaf lower surface not whitish felty or, if so, bark tawny-brown, and buttresses not grouped……………………………………………………………………………………7

7. Buttresses low, stout; bark surface smooth except in very large trees; inner bark homogeneous, pale cream-brown; wood dense, fine textured, ray ends not glistening on tangential surface. Leaf intercostal venation generally reticulate but not drying darker than the leaf blade…………………………………………………………..…**9. Vatica**
Bark surface, if smooth, then tree with prominent buttresses; inner bark fibrous; wood dense, ray ends glistening on tangential surface. Leaf intercostal venation scalariform or if reticulate, drying much darker than the leaf blade……………………………………8

8. Leaf lateral veins densely parallel, variously unequal to subequal...........................…
…………………………………………………………...**5. Hopea** (in part; many species)
Leaf lateral veins strictly pinnate, sometimes with short intermediates only………...…9

9. Wood dense, hard, ray ends not glistening on tangential surface……………………...10
Wood not dense, not hard, ray ends glistening on tangential surface…………………11

10. Inner bark yellowish brown or, if reddish, closely even-textured, not fibrous…………...
………………**7. Shorea** (in part; *selangan batu*) and **5. Hopea** (in part; some species)
Inner bark fibrous, reddish orange, pale at cambium…………………………………...…
…………………………………**7. Shorea** (in part; *S. inaequilateralis* and *S. kunstleri*)

11. Inner bark distinctly tangentially laminated; leaf midrib obscure, sunken above………..
………………………………………………………...**7. Shorea** (in part; white meranti)

Inner bark not distinctly laminated; leaf midrib usually evident, if furrowed, occasionally obscure above……………………………………………………………12

12. Inner bark greenish yellow; dammar blackish; bark tawny flaky (except in *S. acuminatissima*). Leaf intercostal venation subscalariform, or reticulate and drying darker than the blade……………………………..…**7. Shorea** (in part; yellow meranti)
Inner bark yellowish- to reddish-brown; dammar whitish or yellow or, if blackish, then inner bark pinkish; bark otherwise. Leaf intercostal venation scalariform……………13

13. Bark becoming blackish brown, flaky, with prominent white dammar incrustations; inner bark and sapwood homogeneous, cream…….…**5. Hopea** (in part; e.g., *H. sangal*)
Bark, if blackish, with yellow dammar incrustations, inner bark and sapwood not cream or homogeneous………………………………………………………………….…14

14. Buttresses narrow, frequently with flying buttresses and stilt roots; bark surface chocolate-brown and grey-mottled, remaining smooth or patchily cracked and thinly flaky…………………………………………………………………..…**5. Hopea** (in part)
Buttresses stout, rarely stilted; bark, if remaining smooth, pale not chocolate-brown…... ……………………………………………………**7. Shorea** (in part; most red meranti)

1. **ANISOPTERA** Korth.

(Greek, *anisos* = unequal; *pteron* = wing; the unequal fruit calyx lobes)

kelapok (Iban), *mersawa* (Malay), *pengiran* (preferred name in Sabah)

Kruidk. (1841) 65; King, J. As. Soc. Beng. 62, 2 (1893) 100; Ridley, FMP 1 (1922) 218; Merrill, EB (1921) 400; Slooten, Bull. Jard. Bot. Buitenz. 3, 8 (1926) 3; Symington, Gard. Bull. S. S. 8 (1934) 1, Malay. For. Rec. 16 (1943) 199; Masamune, EPB (1942) 482; Browne, FTSB (1955) 92; Ashton, Gard. Bull. Sing. 20 (1963) 230, MDB (1964) 9, MDBS (1968) 3, FM 1, 9 (1982) 327; Backer & Bakhuizen *f.*, FJ 1 (1964) 329; Meijer & Wood, Sabah For. Rec. 5 (1964) 292; Burgess, TBS (1966) 93; Anderson, CLTS (1980) 110; PROSEA 5, 1 (1993) 94; Kessler & Sidiyasa, TBSA-EK (1994) 89; Coode *et al.* (eds.), CLBD (1996) 66; Newman *et al.*, MDFB-LHW (1996) 57. **Synonyms:** *Antherotriche* Turcz., Bull. Soc. Nat. Mosc. 2 (1846) 505; *Scaphula* Parker *in* Fedde, Rep. 30 (1932) 326.

Emergent trees with stout, short or tall and straight buttresses; crown irregularly hemispherical, rather narrow, often diffuse, with a few large twisted ascending branches. **Bark** *becoming shallowly irregular-section fissured and thinly flaky*; *inner bark prominently tangentially laminated*, thick, fibrous. **Sapwood** pale yellowish white, siliceous; dammar opaque, yellow or white, occurring as smear-like exudates on bole. *Indumentum on young parts and leaf undersurface in part consists of dense unicellular peltate scales.* **Twigs** more or less prominently ribbed on drying. *Leaf buds* ovoid, acute, *small*, *c. 5 × 3 mm*, somewhat compressed. **Stipules** relatively large, *linear-tapering*, *falling early and leaving short scars*. **Leaves** *aestivation not plicate*; thinly to thickly coriaceous, *peltate-lepidote below*; blade oblong-obovate, base usually obtuse, equal, apex shortly acuminate; midrib sunken above; *main lateral veins distinctly raised below*, *curving toward margins and anastomosing to form a distinctly looped intramarginal vein*; *intercostal venation distinct*, *laxly scalariform*, *or subreticulate*, *or reticulate*, prominent and raised below; *petiole* relatively long, *prominently geniculate.* **Inflorescences** racemose, terminal or axillary, pendent; rachis lax, long, many-flowered; bracteoles small, caducous. **Flowers** distichous, pedicellate; buds lanceolate or globose (in *A. laevis*); sepals imbricate to valvate (in *A. laevis*), the 2 outer lobes obtuse, thicker than the 3 acute inner ones; petals linear; stamens *c.* 15 (in *A. laevis*) or more than 30, glabrous, filaments short, tapering, connate at base, anthers latrorse, *connectival appendage slender, at least twice the length of anther*; ovary semi-inferior, with distinct stylopodium, style long or short, stigma distinctly trifid, rarely obscure (in *A. laevis*). **Fruits:** *calyx lobes valvate, with a subglobose base enclosing and adnate to the nut*, with 2 long narrowly spatulate untwisted 3-veined lobes and 3 short lobes. **Nuts** *imbedded in the calyx tube but for the apex*, with broad discoid (in *A. laevis*) or cylindrical stylopodium and persistent columnar (in *A. laevis*) or short style; cotyledons unequal; first leaves paired with interpetiolar stipules, or in a whorl of 4 without stipules; germination epigeal, the pericarp breaking open irregularly.

Distribution. Ten species, ranging from Chittagong (Bangladesh) to S Indo-China, east and southeastwards to New Guinea. Five species in Borneo, all of which occur in Sabah and Sarawak; 2 endemic in Borneo of which one endemic to Sabah, Sarawak and Brunei.

Ecology. In mixed dipterocarp, mixed peat swamp and *kerangas* forests, rarely at altitudes above 1000 m. In our area generally as scattered individuals, but occasionally semi-gregarious in the seasonal tropics.

Uses. The timber is a light hardwood; it is siliceous, but makes excellent peeler for veneer.

Key to *Anisoptera* species

(base on flowering/fruiting specimens)

1. Flower buds subglobose; stamens *c.* 15; stylopodium in flower broad, discoid, glabrous; style columnar, slender, glabrous, stigma obscure (sect. **Glabrae**)…………**3. A. laevis**
   Flower buds spindle-shaped or ovoid-lanceolate; stamens 20–36; stylopodium in flower as broad as ovary, ovoid, oblong to cylindrical, densely pubescent; style and stigma short, trifid (sect. **Anisoptera**)……………………………………………………………..…2

2. Leaf greyish brown or bright yellow lepidote below………………………………..…3
   Leaf golden scaly or glabrous below…………………………………………………..…4

3. Leaf drying greyish brown above, greyish brown lepidote below; venation below and petiole greyish brown tomentose; stylopodium cylindrical, not tapering at base………...
   ………………………………………………………………………………………**1. A. costata**
   Leaf drying mauve-brown above, bright yellow lepidote below; venation below densely rufous scabrid-pubescent; stylopodium ovoid, tapering at both ends….**2. A. grossivenia**

4. Leaf golden scaly below, matt above; lateral veins slender, hardly raised below; stamens *c.* 25; stylopodium truncate……………………………………**4. A. marginata**
   Leaf not golden scaly below, shiny above; lateral veins stout, prominent below; stamens *c.* 35; stylopodium tapering at apex……………………………………..…**5. A. reticulata**

Key to *Anisoptera* species

(based on field characters)

1. Leaf blade, at least on the veins below and petiole, variously hairy/lepidote…………..…2
   Leaf blade below and petiole glabrous or scaly……………………….…………………4

2. Leaf blade drying mauve-brown above, rufous scabrid-pubescent on the veins below….
   …………………………………………………………………….…**2. A. grossivenia**
   Leaf blade drying greyish brown above, shortly greyish brown lepidote/hairy below….3

3. Leaf blade sparsely scabrid-hairy and greyish brown lepidote below; buttresses tall, straight………………………………………………………….………...**1. A. costata**
   Leaf blade below sparsely tomentose on the veins only; buttresses short…..……………
   ……………….……………………………………….…………**4. A. marginata** (in part)

4. Leaf blade drying yellowish brown below, shiny above; lateral veins prominent below; intercostal venation reticulate…….………………………….……………….…**5. A. reticulata**
   Leaf blade more or less golden scaly below, not shiny above; lateral veins slender; intercostal venation subscalariform…………………………………………………..…5

5. Leaf midrib sharp below, drying conspicuously darker than the leaf blade; twigs pale, striated; bark surface patchily fissured and flaked…………………….…...…**3. A. laevis**
   Leaf midrib rounded below, drying greyish brown; twigs uniform brown; bark closely parallel fissured and flaked……………….………………….…..…**4. A. marginata** (in part)

1. **Anisoptera costata** Korth.

(Latin, *costatus* = ribbed; the prominent venation of the leaf blade)

Kruidk. (1841) 67; Merrill *op. cit.* 400; Slooten *op. cit.* 7, Reinwardtia 2 (1952) 8; Symington *op. cit.* (1934) 9, *op. cit.* (1943) 204; Masamune *op. cit.* 482; Ashton *op. cit.* (1964) 11, *op. cit.* (1968) 5, Gard. Bull. Sing. 31 (1978) 13, *op. cit.* (1982) 330; Meijer & Wood *op. cit.* 293; Burgess *op. cit.* 93; Anderson *op. cit.* (1980) 110; PROSEA *op. cit.* 99; Newman *et al. op. cit.* 60; Coode *et al.* (eds.) *op. cit.* 66. **Type:** *Korthals s.n.* (= *RHL Sheet No. 90214642*), Borneo, S Kalimantan, G. Sakumbang, Tanah Laut (holotype L). **Synonyms:** *Anisoptera oblonga* Dyer, Fl. Brit. Ind. 1 (1874) 301; *A. cochinchinensis* Pierre *in* Lanessan, Pl. Util. Colon. Fr. (1886) 268; *A. robusta* Pierre, Fl. For. Coch. 3 (1889) *t.* 236; *A. marginatoides* F.Heim, Bot. Tidsskr. 25 (1902) 44; *A. mindanensis* Foxw., Philip. J. Sci. 13 (1918) Bot. 181.

Huge tree, to 65 m tall, to 1.5 m diameter; *buttresses massive*, *straight*, *to 4 m tall and continuing as ribs up bole to 10 m.* **Bark** greyish brown, vertically fissured and thinly flaking; inner bark laminated cream and pale yellow; dammar secretions as greyish green smears. *Young parts more or less sparsely greyish brown hairy.* **Leaves** thinly coriaceous, frequently slightly bullate, *sparsely scabrid-hairy and greyish brown lepidote below*, *drying greyish brown above*; blade oblong to obovate, 6–18 × 7–11 cm, base obtuse or broadly cuneate, apex with an acumen to 0.5 cm long; *lateral veins* 8–22 pairs, prominent and *tomentose below*; *petiole* 2–4 cm long, *greyish brown short-hairy.* **Inflorescences** to 20 cm long, pubescent. **Flowers:** *buds ovoid-lanceolate*, to 12 × 6 mm; corolla cream, petals narrow; *stamens c. 25*, subequal, anthers oblong, tapering, connectival appendage *c.* twice the length of anther, tapering; *stylopodium cylindrical*, *somewhat tapering apically*, *not tapering at base*, *densely pubescent*; *style and stigma short*, *trifid*. **Fruits:** calyx tube to 1.2

cm diameter, puberulent; calyx lobes glabrous, 2 longer lobes spatulate, to 16 × 2 cm, constricted to *c.* 5 mm at base, 3 shorter ones hastate, to 2 × 0.4 cm, hardly constricted at base. **Nut** apex broadly conical, shortly pubescent; stylopodium cylindrical, *c.* 2.5 × 1.5mm.

Vernacular names. Sabah—*pengiran kesat* (preferred name). Sarawak—*mersawa kesat* (preferred name).

Distribution. Coastal hills of Myanmar, S and C Thailand, Cambodia and Cochin-China, Sumatra, Peninsular Malaysia, W Java, Borneo, the Philippines (Mindanao), and Maluku. In Borneo, scattered throughout Sabah and recorded from Keningau, Kota Marudu, Lahad Datu, Sandakan, Semporna, and Tawau districts (e.g., *FMS 41471*, *FMS 48764*, *SAN 7839*, *SAN 15283*, *SAN 21511*, and *SAN 122039*) and in Sarawak from Limbang district (e.g., *S 32209*). Also occurring in Brunei (e.g., *BRUN 3387*, *BRUN 3389* and *BRUN 5651*) and Kalimantan (e.g., *bb. 31198*, *Kostermans 4384* and *Kostermans 10577*).

Ecology. Evergreen and semi-evergreen lowland forests of Indo-Burma; in mixed dipterocarp forests on clay ultisols in Sabah and Sarawak, at altitudes to 700 m. Uncommon, vulnerable.

2. **Anisoptera grossivenia** Slooten

(Latin, *grossus* = an unripe fig, *venius* = veined; the purple lateral veins of the leaf blade)

Bull. Jard. Bot. Buitenz. 3, 16 (1940) 431; Symington *op. cit.* (1943) 13; Masamune *op. cit.* 483; Browne *op. cit.* 93; Ashton *op. cit.* (1964) 12, *op. cit.* (1968) 55, *op. cit.* (1982) 331; Meijer & Wood *op. cit.* 296; Burgess *op. cit.* 94; Anderson *op. cit.* (1980) 110; PROSEA *op. cit.* 100; Coode *et al.* (eds.) *op. cit.* 66; Newman *et al. op. cit.* 61. **Type:** *bb. 29708*, Borneo, Kalimantan, Dusun Lands, Pepas, Muara Teweh (holotype BO; isotypes KEP, L).

Tree to 60 m tall, to 1.5 m diameter; buttresses low, stout. **Bark** purplish brown, closely fissured and flaking; inner bark pale yellow and rich orange laminated; dammar smears rich yellow, long. *Leaf venation below*, *petiole*, *stipule outside*, *buds*, *inflorescence*, *and twig persistently rufous scabrid-pubescent.* **Leaves** often slightly bullate, *drying mauve-brown above*, *brilliant yellow lepidote below* (juveniles excepted); blade narrowly obovate to oblong, 9–12 × 3–5 cm, base cuneate, margin slightly recurved, apex with narrow acumen to 1 cm long; lateral veins 18–28 pairs, dense, arched; intercostal venation hardly raised (juveniles excepted), subreticulate; petiole 2–2.5 cm long. **Inflorescences** to 20 cm long. **Flowers:** *buds lanceolate*, to 5 × 2.5 mm long; corolla magenta in bud, yellow on opening, petals narrow; *stamens c. 36*, anthers subglobose, connectival appendage *c.* thrice as long as anther, slender; *stylopodium ovoid*, *tapering at both ends*, *densely golden pubescent*; *style and stigma short*, *trifid*. **Fruits:** calyx sparsely puberulent; tube to 1.3 cm diameter; 2 longer calyx lobes narrowly spatulate, to 20 × 2.5 cm, constricted to *c.* 5 mm at base, 3 shorter ones linear, to 0.6 cm long. **Nut** apex obtuse, densely rufous puberulent; stylopodium oblong-ovoid, *c.* 8 × 2 mm.

Vernacular names. Sabah—*pengiran kunyit* (preferred name). Sarawak—*mersawa kunyit* (preferred name).

Distribution. Endemic in Borneo. Widespread throughout the lowlands of Sabah and recorded from Beaufort, Sandakan and Sipitang districts (e.g., *KEP 80257*, *SAN 15058* and *SAN 15159*) and in Sarawak from Belaga, Kuching, Lawas, Lundu, and Miri districts (e.g., *S 8915*, *S 9617*, *S 10285*, *S 22312*, and *S 46495*). Also occurring in Brunei (e.g., *BRUN 3028*, *BRUN 3055*, *BRUN 3286*, *S 1644*, and *S 5780*) and C and NE Kalimantan (e.g., *bb. 22874*, *bb. 29605*, *Jarvie & Ruskandi 5896*, and *Kostermans 9113*) where its habitat occurs.

Ecology. In mixed dipterocarp forest and its ecotone to *kerangas* forest, on shallow and deep yellow sandy soils, at altitudes below 400 m. Well represented in Bako and Lambir NPs and not currently endangered.

3. **Anisoptera laevis** Ridl. Fig. 1.

(Latin, *levis* = smooth; the leaf blade)

FMP 1 (1922) 219; Symington *op. cit.* (1943) 205; Ashton *op. cit.* (1964) 13, *op. cit.* (1968) 5, *op. cit.* (1982) 335; Meijer & Wood *op. cit.* 298; Burgess *op. cit.* 94; Anderson *op. cit.* (1980) 100; PROSEA *op. cit.* 101; Coode *et al.* (eds.) *op. cit.* 66; Newman *et al. op. cit.* 62. **Type:** *Ridley SFN 6886*, Singapore Botanic Gardens (holotype SING; isotype KEP).

Vast emergent tree, to 65 m tall, to 2 m diameter; buttresses to 15 m tall, 4 m wide, stout. **Bark** pale greyish buff, *patchily fissured and flaked*; inner bark pale brownish laminated, rather thin; dammar in greyish brown smears, often not present. *Young parts pale brown to rust caducous lepidote*, *epilose* (without hairs). **Twigs** *pale*, *striated.* **Leaves** flat, *golden scaly below* (mature trees), *not shiny above*, drying pale greenish brown below; blade oblong-obovate, 7–11 × 3–4 cm, base obtuse or broadly cuneate, apex with an acumen to 1 cm long; *midrib sharp below*, *drying conspicuously darker than the blade*; *lateral veins 10–14 pairs*, *slender*; *intercostal venation subscalariform*; *petiole* 1.5–2 cm long, *minutely scaly*. **Inflorescences** to 12 cm long, pale brown caducous puberulent. **Flowers:** *buds subglobose*; petals small, elliptic-oblong, pale yellow; *stamens c. 15*, anther narrowly oblong, connectival appendage short, erect; *stylopodium discoid*, *glabrous*; *style columnar*, *glabrous*, *stigma obscurely 3-lobed*. **Fruits:** calyx glabrous; tube to 1.5 cm diameter; 2 longer lobes spatulate, to 15 × 1.5 cm, 3 shorter ones hastate, linear, to 1.5 × 0.3 cm, slightly recurved. **Nut** apex discoid, puberulent; style remnant to 8 mm long, prominent, filiform.

Vernacular names. Sabah—*pengiran durian* (preferred name). Sarawak—*mersawa durian* (preferred name).

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo. In Borneo, known in Sabah from Beaufort, Sipitang and Ranau districts (e.g., *SAN 15083* and *SAN 16944*) and in Sarawak from Bau, Kapit, Lawas, Limbang and Tatau districts (e.g., *S 1109*, *S 17756*, *S 22279*, *S 22305*, *S 24810*, and *S 32297*). Also occurring in Brunei (e.g., *BRUN 3053*, *BRUN 3192*, *BRUN 5251*, *FMS 35455*, and *S 5780*).

Ecology. Widespread but uncommon in mixed dipterocarp forest on clay loam soils derived from shale and basic to intermediate volcanic rocks. Recorded from Mulu NP but vulnerable.

4. **Anisoptera marginata** Korth. Fig. 2G–H.

(Latin, *marginatus* = bordered; the distinct intramarginal vein of the leaf blade)

Kruidk. (1841) 66; Merrill *op. cit.* 401; Slooten *op. cit.* 5; Masamune *op. cit.* 483; Symington *op. cit.* (1943) 206; Anderson, Gard. Bull. Sing. 20 (1963) 157, *op. cit.* (1980) 110; Ashton *op. cit.* (1964) 14, *op. cit.* (1968) 5, *op. cit.* (1982) 328; Meijer & Wood *op. cit.* 298; Burgess *op. cit.* 93; PROSEA *op. cit.* 101; Coode *et al.* (eds.) *op. cit.* 66; Newman *et al. op. cit.* 63. **Type:** *Korthals s.n.* (= *RHL Sheet No. 90214648*), Borneo, Kalimantan, G. Pamaton (holotype L). **Synonym:** *Anisoptera grandiflora* Brandis, J. Linn. Soc. Bot. 31 (1895) 43.

Tree to 45 m tall, to 1.5 m diameter; *buttresses low, rounded.* **Bark** greyish brown, *shallowly fissured and flaking*; inner bark brown and cream laminated, thick; dammar as greyish cream smears. **Twigs** *uniformly brown. Young parts greyish brown pubescent.* **Leaves** *matt above, golden to greyish brown lepidote below or sparsely tomentose on the lateral veins only*, drying greyish to yellowish brown, shallowly bullate in juveniles; blade oblong-obovate, 7–10 × 3.5–4.5 cm, base obtuse or broadly cuneate, apex with an acumen to 0.6 cm long; *midrib round below, drying the same colour as the blade*; *lateral veins* 10–14 pairs, *slender, hardly raised below*; *intercostal venation subscalariform*; petiole 1.5–2 cm long. **Inflorescences** to 14 cm long. **Flowers:** *buds lanceolate*, to 8 × 3.5 mm; petals broadly elliptic, pale yellow; *stamens c. 25*, anther oblong, connectival appendage *c.* twice the length of anther, slender; *ovary and stylopodium puberulent*, *stylopodium cylindrical*, *truncate*, *style and stigma short*, *trifid*. **Fruits:** calyx tube to 1.3 cm diameter; 2 longer calyx lobes spatulate, to 12 × 2 cm, 3 shorter ones linear, to 2 × 0.3 cm. **Nut** apex almost flat; stylopodium oblong, *c.* 3 × 1.5 mm.

Vernacular names. Sabah—*pengiran kerangas* (preferred name). Sarawak—*mersawa paya* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo (widespread). In Sabah known from Beaufort, Sandakan and Tawau districts (e.g., *D.D. Wood 2386*, *SAN 18461* and *SAN 31588*) and in Sarawak from Belaga, Betong, Kapit, Lawas, Limbang, Lundu, Marudi, Miri, Sibu, Sri Aman, and Tatau districts (e.g., *S 8038*, *S 18862*, *S 21177*, *S 26550*, and *S 69174*). Also occurring in Brunei (e.g., *FMS 30418*, *Niga NN 153* and *Wong s.n.*) and Kalimantan (e.g., *bb. 2624*, *bb. 9431*, *Endert 5056*, *Kostermans 7144*, and *Kostermans 8896*).

Ecology. In mixed peat swamp forest both in the coastal swamps and, rarely, inland valleys; and in poorly drained *kerangas* forest, sandy hill crests, and in Sabah on ultrabasic rocks, at altitudes to 850 m, as scattered trees or locally frequent. Recorded from Mulu NP; vulnerable, possibly endangered.

5. **Anisoptera reticulata** P.S.Ashton Fig. 2A–F, Plates 2A–B.

(Latin, *reticulatus* = netted; the intercostal venation of leaf blade)

Gard. Bull. Sing. 22 (1967) 260, *op. cit.* (1968) 5, *op. cit.* (1982) 333; Coode *et al.* (eds.) *op. cit.* 67; Newman *et al. op. cit.* 64. **Type:** *G.H.S. Wood SAN 15172*, Borneo, Sabah, Ulu Sipitang (holotype K; isotypes KEP, L, SAN).

Large tree, to 65 m tall, to 2 m diameter, with short rounded buttresses. **Bark** pale yellowish brown, vertically fissured and flaky. *Young parts at first*, *inflorescence*, *flower bud*, *ovary*, *stylopodium*, *and fruit calyx golden brown puberulent*; *parts otherwise glabrous.* **Leaves** thickly coriaceous, *drying yellowish brown below*, *shiny above*, *glabrous*; blade elliptic-

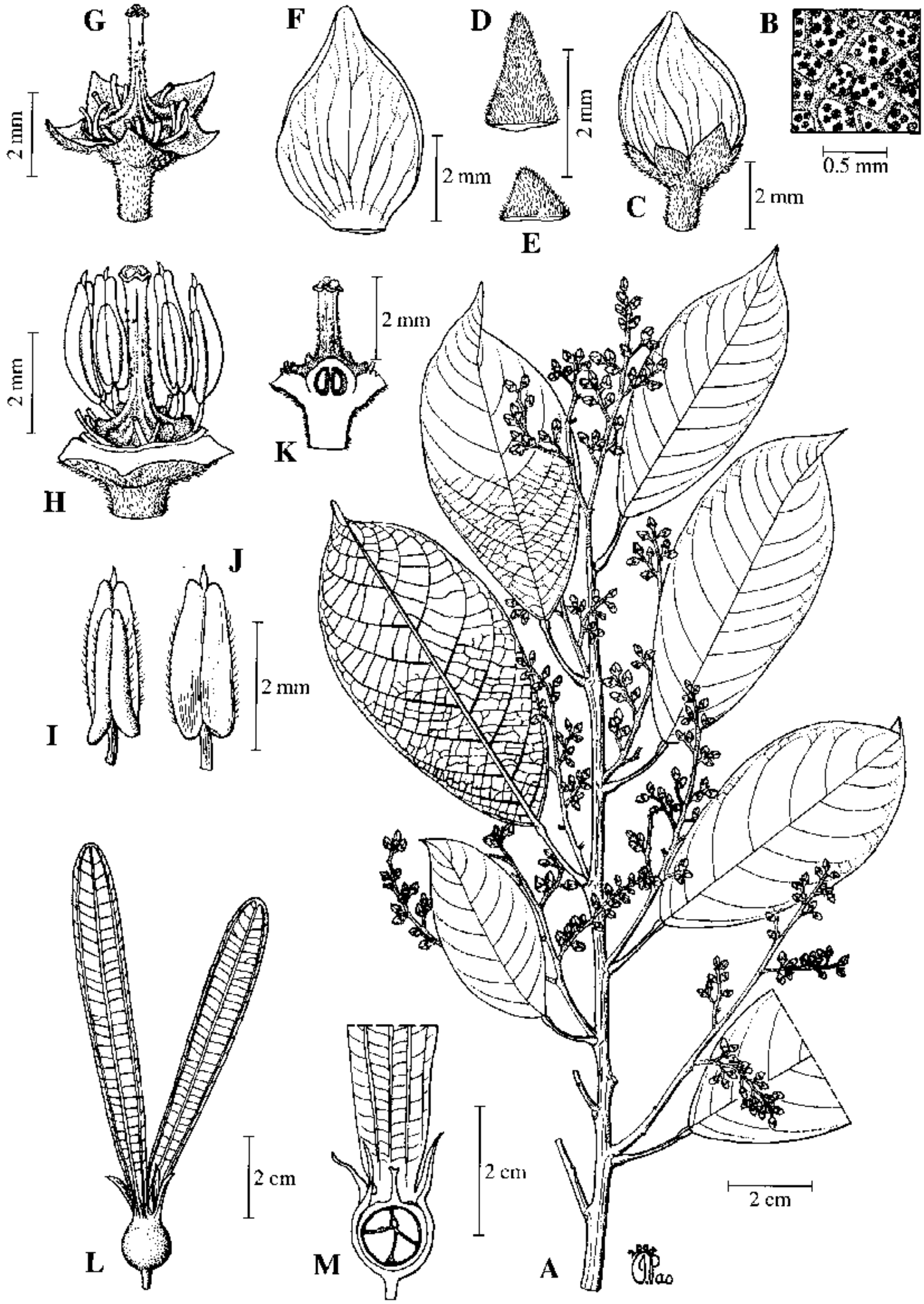

Fig. 1. *Anisoptera laevis*. A, flowering leafy twig; B, detail of venation and indumentum on lower leaf surface; C, flower bud; D, abaxial view of larger sepal; E, abaxial view of smaller sepal; F, adaxial view of petal; G, flower bud with petals and stamens removed; H, flower bud with sepals, petals removed; I, adaxial view of stamen; J, abaxial view of stamen; K, longitudinal section of gynoecium; L, fruit; M, longitudinal section of fruit. (A–K from *SAN 15083*, L–M from *Ridley 6886*.)

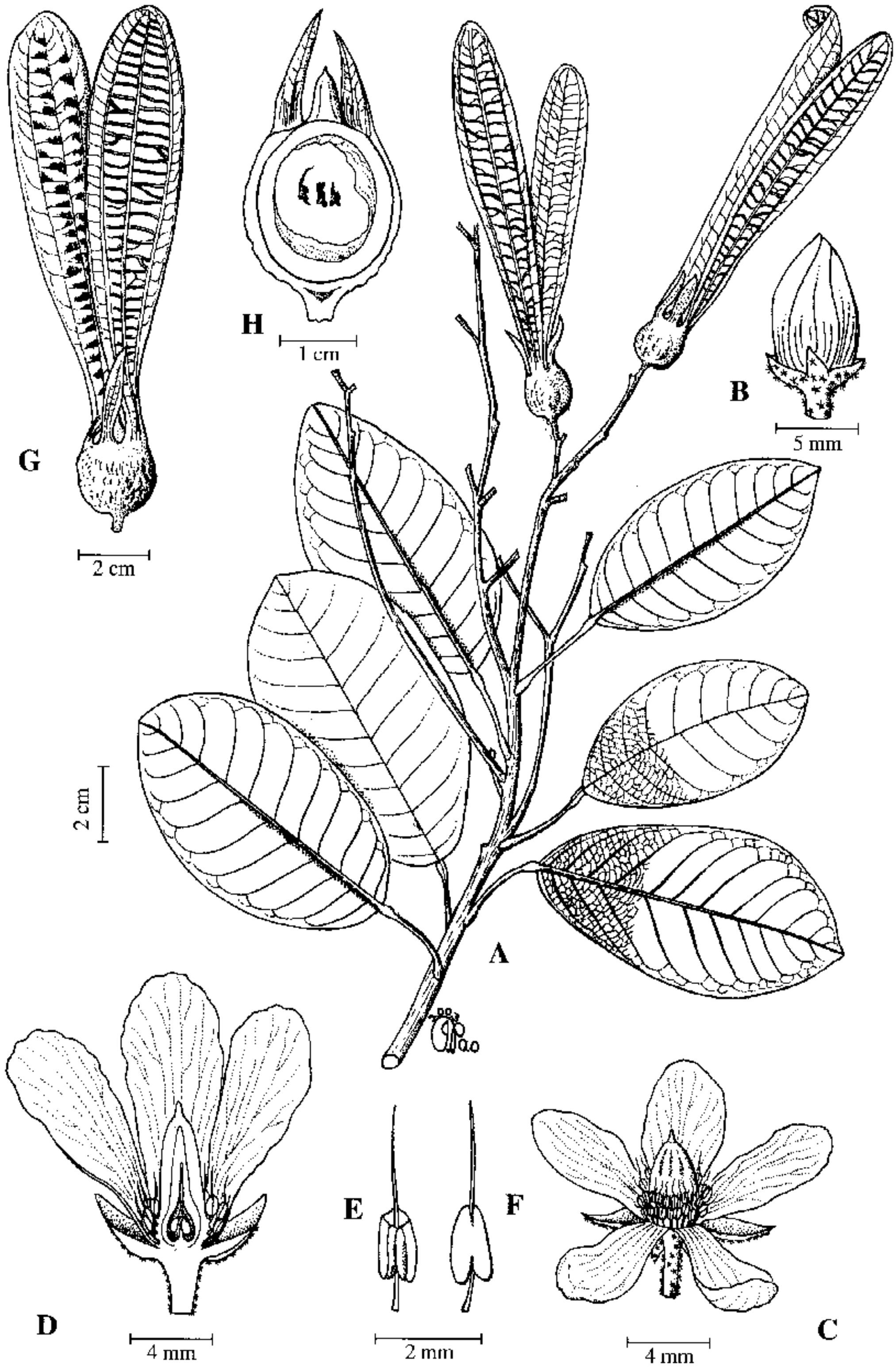

Fig. 2. *Anisoptera reticulata* (A–F) and *A. marginata* (G–H). A, fruiting leafy twig; B, flower bud; C, open flower; D, longitudinal section of open flower; E, adaxial view of stamen; F, abaxial view of stamen; G, mature fruit; H, longitudinal section of mature fruit. (A from *SAN 92981*, B–F from *FRI 41363*, G–H from *Niga NN 153*.)

obovate, 4.5–13 × 2.2–5 cm, base broadly cuneate, apex shortly abruptly acuminate; midrib flat or slightly sunken above, prominent below; *lateral veins 9–14 pairs*, *stout and elevated below*; *intercostal venation reticulate*; petiole 1.5–3.5 cm long, drying black. **Inflorescences** to 6 cm long. **Flowers:** *buds spindle-shaped*; corolla cream; *stamens c. 35*, subequal, anthers oblong, tapering, connectival appendage filiform; *stylopodium oblong*, *tapering at apex*, *densely puberulent*; *style and stigma short*, *trifid*. **Fruits:** calyx tube to 2 cm diameter; 2 longer calyx lobes lorate-spatulate, to 13 × 3 cm, constricted to *c.* 9 mm at base, 3 shorter ones linear-lanceolate, to 2 × 0.3 cm; stylopodium remnant oblong, to 4 × 3 mm, obtuse.

Vernacular name. Sabah—*pengiran gajah* (preferred name).

Distribution. Endemic in Borneo. In Sabah recorded from Kinabatangan, Labuk Sugut, Ranau, Sandakan, and Sipitang districts (e.g., *FRI 41363*, *SAN 15172*, *SAN 92981*, *SAN 75357*, and *SAN 100178*) and in Sarawak from Belaga, Lawas and Miri districts (e.g., *S 1503*, *S 66963*, *S 68906*, and *S 68908*). Also occurring in Brunei (e.g., *Wong WKM 1654*).

Ecology. Rare, in mixed dipterocarp forest on yellow sandy soils overlying Miocene sandstone, at altitudes to 400 m. Recorded from Mulu NP; endangered.

2. **COTYLELOBIUM** Pierre

(Greek, *kotyle* = a small cup, *lobos* = a pod; the receptacle)

resak (preferred name)

Fl. For. Coch. 3 (1889) *sub. t.* 235; Merrill, EB (1921) 408; Ridley, FMP 1 (1922) 239; Foxworthy, Malay. For. Rec. 10 (1932) 245; Slooten, Bull. Jard. Bot. Buitenz. 3, 10 (1929) 393, Bull. Jard. Bot. Buitenz. 3, 12 (1932) 43; Masamune, EPB (1942) 484; Symington, Malay. For. Rec. 16 (1943) 232; Ashton, MDB (1964) 56, MDBS (1968) 24, FM 1, 9 (1982) 340; Meijer & Wood, Sabah For. Rec. 5 (1964) 323; Burgess, TBS (1966) 226; Anderson, CLTS (1980) 110; PROSEA 5, 1 (1993) 139; Kessler & Sidiyasa, TBSA-EK (1994) 90; Coode *et al.* (eds.), CLBD (1996) 67. **Synonym:** *Dyerella* F.Heim, Rech. Dipt. (1892) 123.

Main canopy and emergent trees with dense even dome-shaped crowns; buttresses low, stout, rounded. **Bark** *at first greyish*, *smooth*, *hoop-marked*, *becoming irregularly flaky to shaggy* (in *C. lanceolatum*), *flakes leaving scroll-marked surfaces*; *inner bark homogeneous pale brown*; dammar and sapwood as in *Vatica*. **Twigs** slender, greyish brown tomentose, terete. Leaf buds small. **Stipules** fugaceous. **Leaves** *epilose or tomentose below*; blade oblong to ovate-lanceolate, margin revolute; *lateral veins slender*, *unraised above and hardly so below*, *arched*, *bifurcating towards the margin and anastomosing to form a looped intramarginal vein*, *with many shorter intermediates similarly bifurcating*; *intercostal venation* reticulate, *obscure*; *petiole* short, *not geniculate*. **Inflorescences** axillary or rarely terminal panicles. **Flowers:** buds ovoid-lanceolate; corolla cream, petals free, elliptic-oblong; *stamens to 15*, in 3 whorls, filaments short and deltoid or filiform, connate at base, *anthers linear oblong*, latrorse, *setose along the margins*, *connectival appendage slender*, *shorter than anther*; ovary free, globose, pubescent around base, *style filiform*, *many times longer than ovary*, *stigma small*, *trifid*. **Fruits:** calyx with 2 long and 3 short lobes, *the lobes united at base into a shallow cup*. **Nuts** free from calyx base, *round in cross-section*.

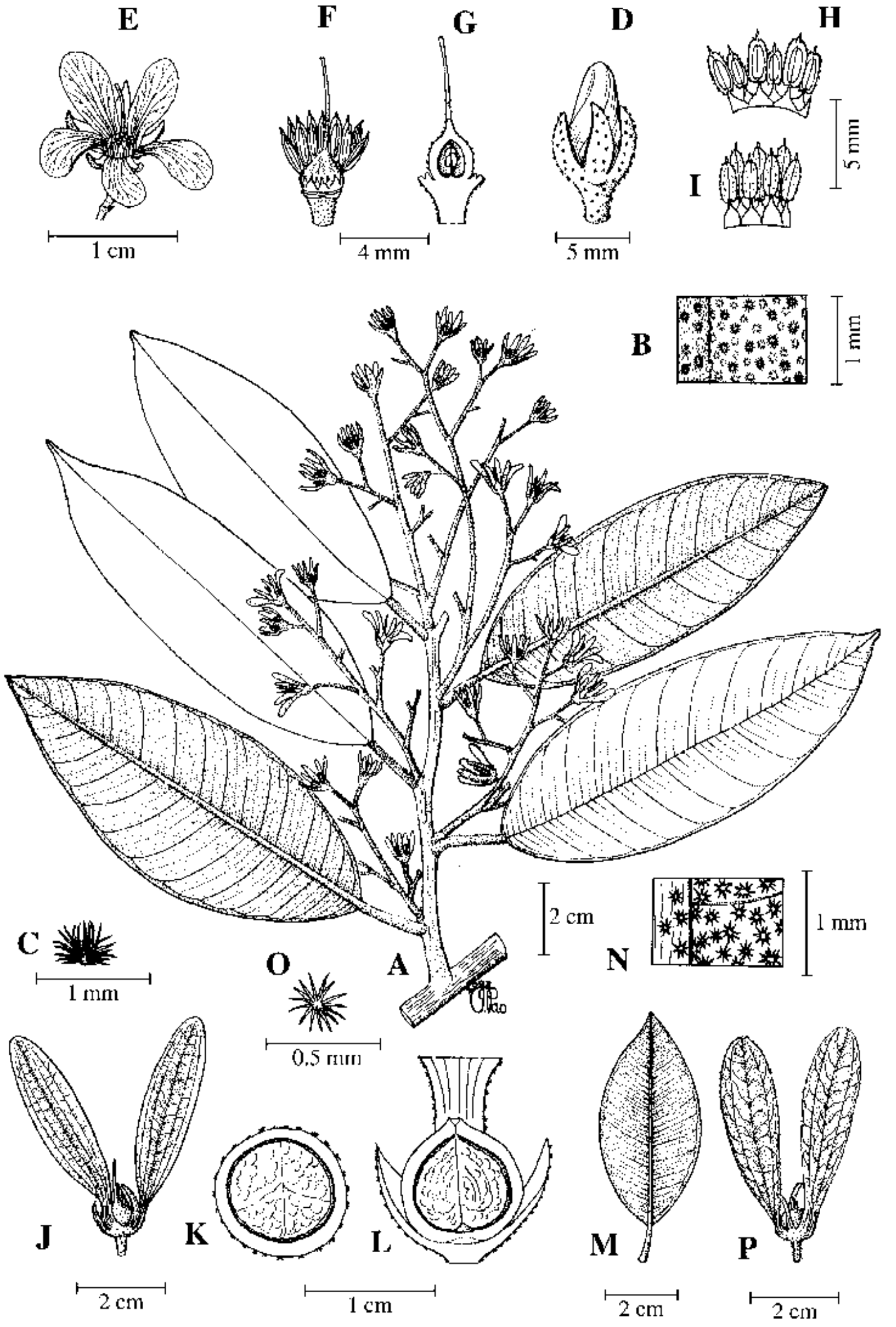

Fig. 3. *Cotylelobium burckii* (A–L) and *C. lanceolatum* (M–P). A, leafy twig bearing post-anthesis flowers and very young fruits; B, detail of indumentum on lower leaf surface; C, side view of tufted hairs; D, flower bud; E, open flower; F, open flower with sepals, petals and several stamens removed; G, longitudinal section of gynoecium; H, adaxial view of stamens; I, abaxial view of stamens; J, mature fruit; K, transverse section of mature fruit; L, longitudinal section of mature fruit; M, lower leaf surface; N, detail of indumentum on lower leaf surface; O, oblique top view of tufted hairs; P, mature fruit. (A–C from *Egon 610*, D–I from *S 37031*, J–L from *Wong WKM 937*, M–P from *bb. 29668.*)

Distribution. Five species distributed in Sri Lanka, Peninsular Thailand, Sumatra, Peninsular Malaysia, and Borneo; 3 species in Sabah and Sarawak.

Ecology. Locally common in mixed dipterocarp, *kerangas* and lower montane forests at altitudes to 1500 m, on humic yellow and white more or less sandy soils on well drained sites.

Use. *Cotylelobium melanoxylon* reaches commercial size, and its hard dark brown heartwood is used for heavy construction.

Notes. An interesting small genus with a curious disjunct distribution; its leaves recall those of the archaic dipterocarp of the ancient sandstone Guyana Highlands, *Pakaraimaea*. Species occurring in Sabah and Sarawak are sometimes difficult to distinguish, populations sometimes exhibiting one or more characters intermediate between two species; the commonest forms of such variation are noted under the relevant species.

Key to *Cotylelobium* species

(based on field characters)

1. Leaf blade sparsely puberulent or glabrescent, drying dull olive-brown………………………………………………………………………………………**3. C. melanoxylon**
   Leaf blade densely tomentose below……………………………………………………2

2. Leaf blade oblong-lanceolate, larger, 8–12 × 3–4.5 cm, drying dull olive-brown above, densely shortly evenly bright yellowish ochre tomentose below; intramarginal vein close to margin……………………………………………………………**1. C. burckii**
   Leaf blade narrowly ovate-lanceolate, smaller, 6–8 × 2.5–3 cm, drying dark greyish brown above, densely dark grey scabrid-tomentose below; intramarginal vein distant from the margin……………………………………………………………**2. C. lanceolatum**

1. **Cotylelobium burckii** (F.Heim) F.Heim Fig. 3A–L

(W. Burck, 1848–1910, botanist of Dipterocarpaceae and Sapotaceae)

Rech. Dipt. (1892) 122; Slooten, Bull. Jard. Bot. Buitenz. 3, 9 (1927) 78; Ashton, Gard. Bull. Sing. 20 (1963) 243, *op. cit.* (1964) 57, *op. cit.* (1968) 24, *op. cit.* (1982) 342; Anderson *op. cit.* 110; PROSEA *op. cit.* 142; Coode *et al.* (eds.) *op. cit.* 67. **Basionym:** *Vatica burckii* F.Heim, Bull. Mens. Soc. Linn. Paris 2 (July 1891) 956. **Type:** *Beccari PB 3260*, Borneo, Sarawak, Marop (holotype P-C). **Synonyms:** *Cotylelobium flavum* Pierre, Fl. For. Coch. 4 (Oct. 1891) *t.* 258A, Merrill *op. cit.* 408, Slooten *op. cit.* (1929) 396, Foxworthy *op. cit.* 246, Symington, Gard. Bull. S. S. 8 (1934) 36, Masamune *op. cit.* 484, Brown, FTSB (1955) 95; *C. asperum* Slooten *op. cit.* (1929) 401.

Main canopy tree, to 40 m tall, to 70 cm diameter. *Young parts*, *buds*, *leaf midrib below*, *petiole*, *inflorescence*, *and ovary densely shortly evenly persistently buff-pubescent*. **Leaves** thickly coriaceous, *drying dull olive-brown above*, *densely bright ochreous tomentose below*; *blade oblong-lanceolate*, *8–12 × 3–4.5 cm*, base broadly cuneate to obtuse, margin prominently revolute, apex with acumen to 0.7 cm long; lateral veins 10–12 pairs, hardly elevated, comparatively straight; *intramarginal vein close to the margin*; petiole 1.5–2 cm long. **Inflorescences** to 15 cm long, axillary or rarely terminal. **Flowers:** buds ovoid-lanceolate, to 10 × 4 mm, acute; calyx lobes linear, obtuse, 3 shorter lobes lanceolate, acute; petals narrowly oblong, glabrous; stamens inner 5 slightly longer than the others, connectival appendage *c.* ¼x as long as anther; ovary subglobose, densely tomentose, styles slender, 3–4 times as long as ovary. **Fruits:** calyx densely tomentose, 2 longer lobes *c.* 1.5 cm broad, 3 shorter ones linear, to 1.2 cm long.

Vernacular name. Sarawak—*resak durian* (preferred name).

Distribution. Endemic in Borneo; absent from Sabah. In Sarawak known from Bau, Bintulu, Kuching, Lawas, Marudi, Miri, Mukah, Sibu, and Sri Aman districts (e.g., *S 17870*, *S 37121*, *S 47027*, *S 66782*, *S 72947*, and *S 73349*). Also occurring in Brunei (e.g., *BRUN 70*, *FMS 32615*, *S 7805*, and *Wong WKM 935*) and C and SE Kalimantan (e.g., *bb. 19876*, *bb. 23501* and *bb. 29681*).

Ecology. Locally common in *kerangas* forest on deep white sand podsols on raised beaches behind present and Pleistocene coastlines, rare on sandstone, at altitudes to 300 m. Vulnerable owing to the destruction of its habitat, but well represented in Bako NP and occurring in Mulu NP.

2. **Cotylelobium lanceolatum** Craib Fig. 3M–P

(Latin, *lanceolatus* = in the form of a lance; the shape of leaf blade)

Bull. Misc. Inform. Kew (1913) 113; Ashton *op. cit.* (1982) 343; PROSEA *op. cit.* 142; Coode *et al.* (eds.) *op. cit.* 67. **Type:** *East Asiatic Co. H 20171*, Thailand, Surat (holotype K). **Synonyms:** *Cotylelobium malayanum* Slooten *op. cit.* (1932) 43, Foxworthy *op. cit.* 247, Symington Gard. Bull. S. S. 9 (1938) 349, *op. cit.* (1943) 235, Browne *op. cit.* 95, Ashton *op. cit.* (1964) 58, Meijer & Wood *op. cit.* 324, Anderson *op. cit.* 111; *C. flavum auct. non* Pierre: Ridley *op. cit.* 239, Slooten *op. cit.* (1929) 396, *p.p.*, Foxworthy *op. cit.* 247.

Main canopy tree, to 45 m tall, to 1.2 m diameter. **Bark** eventually densely shaggy. *Young parts*, *buds*, *leaf venation below*, *petiole*, *and inflorescence densely greyish brown to rufous scabrid-pubescent*; *leaf undersurface and ovary evenly so*. **Leaves** thinly coriaceous, *drying dark greyish brown above*, *densely dark grey scabrid-tomentose below*; *blade narrowly ovate-lanceolate*, *6–8 × 2.5–3 cm*, base broadly cuneate, margin slightly revolute, apex with acumen to 0.5 cm long; *lateral veins* 10–12 pairs, hardly raised below, *joining into a prominent looped intramarginal veins c. 2 mm from margin*; petiole 0.6–1 cm long. **Inflorescences** to 6 cm long, terminal or axillary. **Flowers:** buds ovoid, obtuse, to 8 × 3.5 mm; calyx densely buff-tawny tomentose outside, sparsely so within, lobes deltoid, unequal; petals narrowly oblong, obtuse, glabrous; inner stamens slightly longer than the rest, filaments triangular, anthers narrowly oblong, with prominent setose margin, connectival appendage short, slender; ovary subglobose, densely tomentose, style *c.* 3x as long as ovary. **Fruits:** calyx scabrid-tomentose; 2 larger lobes oblong, to 4.5 × 1.2 cm, 3 shorter ones broadly hastate, 1.2–2 × 0.4 cm.

Vernacular names. Sabah—*resak kelabu* (preferred name). Sarawak—*resak batu* (preferred name).

Distribution. Peninsular Thailand to eastern coastal area of Peninsular Malaysia, Anambas Is. and Borneo. Throughout Borneo where its habitat occurs. In Sabah known from Sandakan, Sipitang and Tawau districts (e.g., *SAN 18651*, *SAN 18652* and *SAN 39272*) and in Sarawak from Bau, Bintulu, Kuching, Lawas, Limbang, Marudi, Miri, Mukah, and Serian districts (e.g., *S 12583*, *S 24065*, *S 28068*, *S 32850*, *S 38295*, and *S 47628*). Also occurring in Brunei (e.g., *BRUN 414*, *BRUN 3045* and *BRUN 5779*) and SE Kalimantan (e.g., *bb. 24015*, *bb. 32387*, *Kostermans 6371*, *Kostermans 9554*, and *Kostermans 12512A*).

Ecology. Locally abundant in *kerangas* forest, on raised beach terraces, sandstone plateaux, and in W Sarawak on organic soils over limestone; locally abundant in lower montane *kerangas* forest on ridges, at altitudes to 1500 m. Common in Bako NP and occurring in Mulu NP; probably not vulnerable.

Notes. Collections from some lowland localities, such as the Bako NP, in Sarawak, have an even, hardly scabrous tomentum but are otherwise typical.

3. **Cotylelobium melanoxylon** (Hook.*f.*) Pierre Fig. 4.

(Greek, *melanos* = blackish, *xylon* = wood; the dark heartwood)

Fl. For. Coch. 3 (1889) *t.* 235; Merrill *op. cit.* (1921) 408; Slooten *op. cit.* (1927) 78, *op. cit.* (1929) 403, *op. cit.* (1932) 44; Masamune *op. cit.* 484; Symington *op. cit.* (1943) 236; Browne *op. cit.* 96; Ashton *op. cit.* (1964) 59, *op. cit.* (1968) 24, *op. cit.* (1982) 341; Meijer & Wood *op. cit.* 324; Burgess *op. cit.* 228; Anderson *op. cit.* 111; PROSEA *op. cit.* 143; Kessler & Sidiyasa *op. cit.* 90; Coode *et al.* (eds.) *op. cit.* 67. **Basionym:** *Anisoptera melanoxylon* Hook.*f.*, Trans. Linn. Soc. 23 (1860) 160. **Type:** *Lowe s.n.*, Borneo, Sabah, Labuan, Lubok Danau (holotype K). **Synonyms:** *Vatica melanoxylon* (Hook.*f.*) Miq., Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 956; *V. beccariana* F.Heim *op. cit.* (1891) 955; *V. harmandii* F.Heim *op. cit.* (1891) 955; *Cotylelobium beccarii* (F.Heim) Pierre *op. cit.* (1891) *t.* 258B, Merrill *op. cit.* 408, Slooten *op. cit.* (1929) 405, Masamune *op. cit.* 484; *C. harmandii* (F.Heim) F.Heim *op. cit.* (1892) 122, Merrill *op. cit.* 408, Masamune *op. cit.* 484; *C. beccarianum* (F.Heim) F.Heim *op. cit.* (1892) 122; *C. leucocarpum* Slooten *op. cit.* (1929) 399, Masamune *op. cit.* 484; *V. leucocarpa* (Slooten) Foxw. *ex* Den Berger & Endert, Med. Proefst. Boschw. 11 (1925) 130.

Emergent tree, to 60 m tall, to 1.5 m diameter. *Young parts shortly more or less sparsely greyish brown puberulent*, *fugaceous except on inflorescence*, *buds*, *calyx base and ovary*, *and occasionally leaf undersurface.* **Leaves** thinly coriaceous, satiny below, *drying dull olive-brown*; blade lanceolate, oblong or ovate, 5–10 × 2–6 cm, base broadly cuneate or obtuse, margin slightly revolute, apex with acumen to 0.8 cm long; lateral veins 10–13 pairs, hardly raised below; intramarginal vein strongly looped, at *c.* 2 mm from margin; petiole 0.9–1.2 cm long. **Inflorescences** to 8 cm long, axillary. **Flowers:** buds ellipsoid, obtuse, to 6 × 3 mm; stamens subequal, filaments *c.* 3x the length of anthers, slender, tapering, connectival appendage *c.* ¼x the length of style; ovary ovoid, densely pubescent, style filiform, *c.* 3x as long as ovary. **Fruits:** 2 longer calyx lobes oblong, obtuse, *c.* 4.5 × 1.2 cm, 3 shorter ones hastate-acute, 0.8–1.4 × 0.2–0.3 cm. **Nuts** ovoid, *c.* 0.6 cm across, style remnant to 5 mm long.

Vernacular names. Sabah—*resak tempurung* (preferred name). Sarawak—*resak hitam* (preferred name).

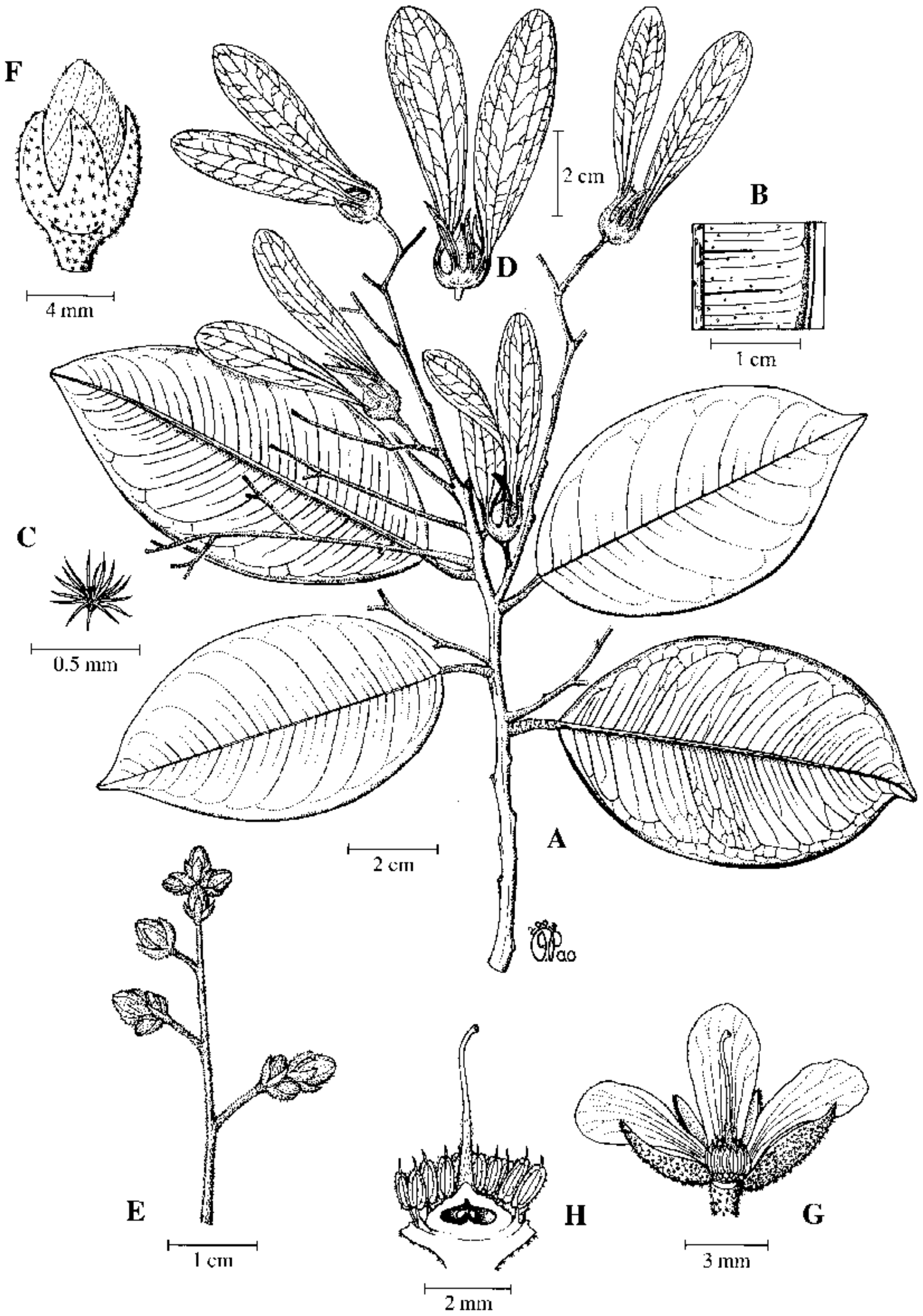

Fig. 4. *Cotylelobium melanoxylon.* A, fruiting leafy twig; B, detail venation on lower leaf surface; C, side view of tufted hairs; D, mature fruit; E, part of inflorescence bearing flower buds; F, flower bud; G, open flower with one sepal and two petals removed; H, longitudinal section of gynoecium and adaxial view of stamens. (A–C from *SAN 56120*, D from *S 15886*, E from *SAN 57677*, F–H from *SAN 37642*.)

Distribution. Sumatra, Peninsular Malaysia (NE Johor) and Borneo (widespread). In Sabah recorded from Beaufort, Kota Kinabalu, Kudat, Labuk Sugut, Sandakan, Sipitang and Tawau districts (e.g., *KEP 80303*, *SAN 15259*, *SAN 17264*, *SAN 38807*, and *SAN 57688*) and in Sarawak from Bintulu, Kuching, Lundu, Marudi, Miri, and Sibu districts (e.g., *S 11855*, *S 12475*, *S 15871*, *S 40315*, and *S 72955*). Also occurring in Brunei (e.g., *BRUN 292*, *BRUN 604*, *FMS 48302*, *NN 98*, and *S 1678*) and E Kalimantan (e.g., *Arifin & Ambriansyah B 1528*).

Ecology. Locally common in mixed dipterocarp forest on yellow sandy soils, and as a smaller, canopy tree, in *kerangas* on podsols; at altitudes below 400 m and usually not far from the coast. Well represented in Lambir and Mulu NPs, but vulnerable outside the parks system.

Notes. The leaf becomes glabrous except in eastern parts of Borneo from Sandakan southwards, where it may remain persistently sparsely puberulent below.

3. **DIPTEROCARPUS** Gaertn.*f.*

(Greek, *di* = two, *pteron* = wing, *karpos* = fruit; the two-winged fruit)

keruing (preferred name), *kesugoi* (Murut), *resak* (Iban), *sugoi* (Murut)

Fruct. 3 (1805) 50; Blume, Bijdr. Fl. Ned. Ind. (1825) 223; King, J. As. Soc. Beng. 62, 2 (1893) 89; Ridley, FMP 1 (1922) 211; Slooten, Bull. Jard. Bot. Buitenz. 3, 8 (1927) 263; Foxworthy, Malay. For. Rec. 10 (1932) 56; Symington, Malay. For. Rec. 16 (1943) 153; Browne, FTSB (1955) 102; Ashton, Gard. Bull. Sing. 20 (1963) 233, MDB (1964) 16, MDBS (1968) 6, Gard. Bull. Sing. 31 (1978) 5, FM 1, 9 (1982) 291; Backer & Bakhuizen*f.*, FJ 1 (1964) 328; Meijer & Wood, Sabah For. Rec. 5 (1964) 230; Burgess, TBS (1966) 99; Anderson, CLTS (1980) 111; PROSEA 5, 1 (1993) 166; Kessler & Sidiyasa, TBSA-EK (1994) 91; Coode *et al.* (eds.), CLBD (1996) 67; Newman *et al.*, MDFB-MHHW (1998) 59.

Emergent or sometimes main canopy trees with irregular crowns arising from a few large twisted ascending branches; buttresses stout, generally low, concave. **Bark** *pale or dark greyish to orange-brown*, *dotted with prominent pale warty lenticels*, *peeling off in irregular usually large flakes*; inner bark warm brown, hard, homogeneous; dammar slow to harden, not usually as smears on bole but exuding from cut surfaces. **Sapwood** pale to dark orange-yellow, grading into rust to pinkish brown heartwood. **Twigs** *with amplexicaul stipule scars*. *Terminal* (*leaf*) *buds prominent*, with species-specific shape and indumentum. **Stipules** *large*, usually strap-shaped. **Leaves** *aestivation plicate*; *coriaceous*, *never silvery below*, *more or less corrugated between the rather straight lateral veins*; margin usually sinuate towards apex; *lateral veins* stout and usually prominent below, *curved only near the margin*; intercostal venation scalariform, usually well-spaced, rarely subreticulate; *petiole* usually long, *prominently geniculate*. **Inflorescences** racemose, terminal or axillary; rachis short, stout, zig-zag, few-flowered, unbranched or sparingly so. **Flowers** large; buds spindle-shaped; calyx united at base into a smooth, angled, tuberculate or flanged tube enclosing but free from ovary, with 5 valvate lobes; petals strap-shaped, cream generally with a pink median stripe, or pink; stamens 15–50, connate at base, falling in a group tardily, filaments compressed, slender tapering, anthers large, elongate, *tapering into a short or prominent stout tapering connectival appendage*; ovary ovoid, pubescent towards apex, tapering into a filiform style, stigma obscure. **Fruits** usually large; *calyx united at base into a tube* *enclosing at least the basal half of the nut*; tube smooth or adorned with 5 species-specific ribs, tubercles, or flanges; *lobes valvate and not incrassate at base*, unequal, 2 longer ones aliform, oblong to spatulate and more or less distinctly 3-veined, and the other 3 short, or all subequal and short. **Nuts** *free within calyx tube*, apex pubescent with short style remnant; germination hypogeal; cotyledons without chlorophyll, intricately folded and trapped within calyx tube, the seedling escaping by elongation of the cotyledonary petioles.

Distribution. About 70 species, distributed from Sri Lanka and S India to Myanmar, Thailand, Indo-China, China (Yunnan), Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, and Lesser Sunda Is. (Bali and Sumbawa). Forty one species occur in Borneo of which 39 in Sabah and Sarawak.

Ecology. All inland lowland habitats in Borneo at altitudes to 900 m, but rare in mixed peat swamp forest. Light demanders as juveniles, they are particularly common on ridges, river banks, and in some *kerangas*, though some are specialists of other habitats. Individual species often occur in extensive populations, more or less without the presence of others.

Uses. Medium hardwoods which readily take preservatives; used for heavy construction, and formerly especially for railway sleepers. The resin was tapped, especially in seasonal climates and not widely in our area, for tallow, varnish and paint manufacture. The wood of *ensurai* (*D. oblongifolius*) was once esteemed for rice mortars.

Notes. Like *Vatica* but unlike most other dipterocarps, species of *Dipterocarpus* are sometimes difficult to identify on leaves alone. The leaf buds though are prominent, and their shape, and tomentum with that of the stipules, provide invaluable diagnostic characters. Fallen twigs with buds attached can nearly always be found.

Key to *Dipterocarpus* species

(based on flowering and/or fruiting specimens)

1. Calyx tube of mature fruit smooth (without ribs, tubercles or flanges)...........................2
Calyx tube of mature fruit ribbed, tuberculate or flanged……………………………..…10

2. Stamens at most 15…………………………………………………………………...…3
Stamens at least 20……………………………………………………………………….4

3. Fruit calyx tube ellipsoid-globose, verrucose-lenticellate………..….**39. D. verrucosus**
Fruit calyx tube ellipsoid, smooth…………………………………………..…**10. D. crinitus**

4. Fruit calyx lobes all short, equal……………………………………..…**37. D. tempehes**
Fruit calyx lobes unequal, 2 large ones wing-like………………………………………5

5. Stamens *c*. 25; short fruit calyx lobes less than 0.7 cm long, hardly recurved…………...
……………………………………………………………………………..**5. D. caudiferus**
Stamens *c*. 30; short fruit calyx lobes at least 0.8 cm long, becoming recurved and revolute...…6

6. Twigs and leaf buds densely ferruginous tomentose………………………………….7
Twigs and leaf buds buff or golden tomentose, or glabrous……………………………..8

7. Leaf blade becoming glabrous……………………………………………**38. D. validus**
Leaf blade persistently tomentose below………………………………**19. D. gracilis**

8. Leaf bud persistently pubescent outside…………**4. D. caudatus** (subsp. **penangianus**)
Leaf bud glabrous outside……………………………………………………………9

9. Inside of stipules densely pubescent; lateral veins at most 11 pairs………**23. D. kerrii**
Stipules entirely glabrous; lateral veins at least 11 pairs…………………**21. D. hasseltii**

10. Fruit calyx tube with prominent sharp or narrowly rounded ribs more or less confined to the distal half, terminating in boss-like tubercles…………………………**24. D. kunstleri**
Fruit calyx tube either ribbed, angled or flanged, or tuberculate…………………………11

11. Mature fruit calyx tube with 5 swelling ribs or tubercles below the neck, otherwise spherical……………………………………………………………………………12
Mature fruit calyx tube angled, ridged, ribbed, or flanged……………………………17

12. Mature fruit calyx tube ovoid…………………………………………**2. D. applanatus**
Mature fruit calyx tube subglobose or globose…………………………………………13

13. Leaves with at most 16 pairs of lateral veins…………………………………14..

14. Leaf blade pale ochreous-pubescent below………………………………**33. D. rigidus**
Leaf blade glabrous……………………………………………………………………15

15. Leaf bud and stipules outside glabrous, sometimes pruinose…………**9. D. costulatus**
Leaf bud and stipules outside tomentose………………………………**18. D. globosus**

16. Fruit calyx lobes all short, subequal……………………………………**12. D. elongatus**
Fruit calyx lobes unequal, 2 larger ones wing-like…………………**22. D. humeratus**

17. Fruit calyx tube with intricately folded flanges………………………………………18
Fruit calyx tube not flanged or if flanged, then the flanges straight or wavy but not intricately folded………………………………………………………………………20

18. Twigs terete; leaf blade concave, venation tomentose below…………**25. D. lamellatus**
Twigs compressed; leaf blade not concave, venation glabrous below………………19

19. Leaf blade ovate-lanceolate, prominently corrugated, margin prominently revolute, lateral veins at least 15 pairs……………………………………………………**26. D. lowii**
Leaf blade broadly ovate, hardly corrugated, margin hardly or not revolute, lateral veins at most 12 pairs……………………………………………………**31. D. pachyphyllus**

20. Fruit calyx tube at least 1½x as long as broad, spindle-shaped or narrowly ellipsoid, or narrowly obovoid……………………………………………………………………21

Fruit calyx tube less than 1½x times as long as broad, more or less globose or broadly ovoid though sometimes with flanges decurrent into pedicel and hence appearing ellipsoid……………………………………………………………………………………30

21. Fruit calyx tube angled or ribbed rather than flanged…………………………………22
Fruit calyx tube distinctly flanged……………………………………………………………23

22. Leaf blade at least 15 cm long, broadly obovate to suborbicular………**6. D. confertus**
Leaf blade at most 12 cm long, narrowly elliptic-lanceolate……………**14. D. fagineus**

23. Fruit calyx tube densely pale buff-pubescent, with very narrow undulate flanges………. …………………………………………………………………………**29. D. oblongifolius**
Fruit calyx tube glabrous; flanges, if narrow, straight…………………………………24

24. Fruit calyx tube flanges at least 8 mm wide…………………………………………25
Fruit calyx tube flanges at most 7 mm wide……………………………………………27

25. Stamens *c.* 30………………………………………………………**20. D. grandiflorus**
Stamens *c.* 15……………………………………………………………………………26

26. Young parts glabrous…………………………………………………**17. D. glabrigemmatus**
Young twig, bud, stipule outside and petiole pubescent…………..**32. D. palembanicus**

27. Fruit calyx tube flanges of constant width…………………………………**28. D. nudus**
Fruit calyx tube flanges widest in the distal half……………………………………28

28. Fruit calyx tube flanges more or less confined to distal half; leaf bud and leaf undersurface pubescent; stamens *c.* 25…………………………………**3. D. borneensis**
Fruit calyx tube flanges continuous from base; tomentum not as above; stamens, if known, *c.* 15……………………………………………………………………………29

29. Leaf bud buff velutinous, leaf blade below sparsely so………………**15. D. fusiformis**
Leaf bud outside and leaf blade glabrous..………………………………**27. D. mundus**

30. Fruit calyx tube persistently pubescent……………………………………………31
Fruit calyx tube glabrescent…………………………………………………………32

31. Leaf including petiole glabrous……………………………………..**16. D. geniculatus**
Leaf below and petiole velutinous..………………..**7. D. conformis** (subsp. **borneensis**)

32. Fruit calyx tube angled or ribbed rather than flanged………………...**1. D. acutangulus**
Fruit calyx tube truly flanged……………………………………………………………33

33. Fruit calyx tube flanges exceeding 10 mm wide………………………………………34
Fruit calyx tube flanges less than 9 mm wide…………………………………………35

34. Fruit calyx tube flanges not decurrent with pedicel, frequently undulate; leaf blade glabrous……………………………………………………………....**36. D. sublamellatus**
Fruit calyx tube flanges decurrent into pedicel; leaf blade densely tomentose below…… ……………………………………………………………………………..**35. D. stellatus**

35. Leaves broadly obovate, apex obtuse or retuse……………………**34. D. sarawakensis**
Leaves narrowly elliptic-ovate, broadly elliptic-ovate to narrowly obovate, apex subacute, acute, acuminate to cuspidate……………………………………………36

36. Leaf blade broader, 10–15 cm wide; fruit calyx tube flanges not continuous to base……
……………………………………………………………………..**8. D. coriaceus**
Leaf blade narrower, 2–9.5 cm wide; fruit calyx tube flanges continuous to base…….37

37. Fruit calyx tube flanges broadest towards apex; leaf apex cuspidate.**11. D. cuspidatus**
Fruit calyx tube flanges of constant width; apex of mature leaf blade not cuspidate….38

38. Mature leaf blade 10–19 × 4.5–9.5 cm……………………………..…**30. D. ochraceus**
Mature leaf blade less than 10 × 4.5 cm………………………………**13. D. eurynchus**

Key to *Dipterocarpus* species
(based on field characters)

1. Leaf lateral veins more than 26 pairs………………………………………………2
Leaf lateral veins less than 25 pairs…………………………………………………3

2. Leaf blade at least 28 × 13 cm……………………………………………**12. D. elongatus**
Leaf blade at most 25 × 12 cm……………………………………**38. D. validus** (in part)

3. Petiole at most 1.3 cm long…………………………………………………………4
Petiole at least 1.3 cm long…………………………………………………………6

4. Leaf apex retuse to obtuse; venation densely tawny long-tomentose below……………
………………………………………………………………………..**34. D. sarawakensis**
Leaf apex acute or acuminate; venation sparsely pubescent or glabrescent below..……5

5. Leaf lateral veins at most 9 pairs. Trees of high shale ridges…………**13. D. eurynchus**
Leaf lateral veins at least 9 pairs. Trees of flood plains……….**37. D. tempehes** (in part)

6. Leaf undersurface persistently (at least sparsely) tomentose……………………………7
Leaf undersurface glabrous or becoming so…………………………………………23

7. Leaf blade prominently concave………………………………………………………8
Leaf blade not concave (though more or less corrugated)……………………………9

8. Petiole less than 4 cm long………………………………………..…**25. D. lamellatus**
Petiole more than 5 cm long……………………………………………**6. D. confertus**

9. Leaf bud glabrous, drying black, or occasionally sparsely tomentose………………10
Leaf bud persistently densely ochreous or brown tomentose…………………………11

10. Leaf lateral veins at least 12 pairs; leaf blade drying greyish brown……………………..
………………………………………………………………………**5. D. caudiferus** (in part)
Leaf lateral veins at most 11 pairs; leaf blade drying warm rust-brown…………………..
…………………………………………………………………….**17. D. glabrigemmatus**

11. Leaf blade densely evenly pale ochreous or pinkish brown tomentose below...........…12
Leaf blade sparsely pubescent, or rust-brown, or scabrid-tomentose below.................14

12. Leaf blade at most 12 × 7 cm, thinly coriaceous; lateral veins 15–18 pairs……………...
……………………………………………………….**7. D. conformis** (subsp. **borneensis**)
Leaf blade at least 13 × 8 cm, thickly coriaceous; lateral veins 12–16 pairs…………...13

13. Tomentum pink. Trees of peat swamp forest…………………………….**8. D. coriaceus**
Tomentum ochre-yellow. Trees of mixed dipterocarp forest……………..…**33. D. rigidus**

14. Leaf blade with *c.* 20 pairs of lateral veins…………………………………………..…15
Leaf blade with less than 18 pairs of lateral veins……………………………………..…16

15. Leaf blade at least 20 × 12 cm; venation sparsely puberulent below....**22. D. humeratus**
Leaf blade at most 15 × 10 cm; venation persistently rust-brown tomentose below……..
……………………………………………………………………………….**19. D. gracilis**

16. Tomentum on twig and leaf bristle-like…………………………………………….…..17
Tomentum, where present, short and even…………………………………………..…19

17. Leaf apex with slender cuspidate acumen; lateral veins at most 9 pairs…………………..
…………………………………………………………………………...**11. D. cuspidatus**
Acumen of leaf apex, if present, broad and tapering; lateral veins at least 12 pairs…...18

18. Leaf blade elliptic, margin revolute, apex obtuse to shortly acuminate….**10. D. crinitus**
Leaf blade ovate, margin not revolute, acumen prominent……………….**35. D. stellatus**

19. Petiole at least 3 cm long……………….………………………………..**16. D. geniculatus**
Petiole at most 2.6 cm long……………………………………………………………..…20

20. Twig stout; leaf bud ovoid-lanceolate. Trees of high hills…………..…**30. D. ochraceus**
Twig slender; leaf bud falcate to linear-lanceolate. Trees of the lowlands…………..…21

21. Leaf blade broadly elliptic-obovate, prominently corrugated..**37. D. tempehes** (in part)
Leaf blade narrowly elliptic to lanceolate, hardly corrugated……………………...…..22

22. Petiole at most 1.7 cm long…………………………………….…**14. D. fagineus** (in part)
Petiole at least 2 cm long……………………………………………...…**15. D. fusiformis**

23. Leaf bud glabrous outside, drying black………………………………………………….24
Leaf bud variously tomentose, drying yellowish, buff, brown or grey……………..…31

24. Leaf bud ovoid, broad and stout…………………………..……**1. D. acutangulus** (in part)
Leaf bud long and slender (falcate)………………………………………………………25

25. Leaf lateral veins usually less than 11 pairs……………………………………….…26
Leaf lateral veins usually more than 11 pairs…………………………………….…27

26. Leaf blade narrowly elliptic to obovate, base narrowly obtuse………..…**27. D. mundus**
Leaf blade broadly elliptic, base cuneate……………………………….…**23. D. kerrii**

27. Petiole at most 2 cm long. Trees of banks of upland rivers………………………………
……………………………………………………………..**29. D. oblongifolius** (in part)
Petiole at least 2.5 cm long. Trees of mixed dipterocarp forest…………………….…28

28. Leaf blade broadly elliptic-ovate, thickly coriaceous and corrugated…..**9. D. costulatus**
Leaf blade narrowly elliptic, thinly coraiceous and hardly corrugated…………….…29

29. Intercostal venation widely scalariform to subreticulate………………..…**28. D. nudus**
Intercostal venation densely regularly scalariform……………………………………30

30. Leaf buds at first hairy…………………………………..…**5. D. caudiferus** (in part)
Leaf buds always glabrous…………………………………………………**21. D. hasseltii**

31. Twigs at least 5 mm diameter apically; petioles at least 2 mm diameter; both stout…..32
Twigs at most 5 mm diameter apically; petioles at most 2 mm diameter; both slender…………………………………………………………………………………….36

32. Leaf lateral veins at least 15 pairs…………………………………………………..…33
Leaf lateral veins at most 15 pairs…………………………………………………..…35

33. Twigs compressed…………………………………………………………………**26. D. lowii**
Twigs terete……………………………………………………………………………34

34. Leaf lateral veins at least 22 pairs; bud and stipules shaggy rust-brown tomentose……..
……………………………………………………………………**38. D. validus** (in part)
Leaf lateral veins at most 17 pairs; bud and stipules shortly evenly buff-pubescent……..
……………………………………………………………………**20. D. grandiflorus**

35. Petiole at least 3.5 cm long……………………………………………..…**2. D. applanatus**
Petiole at most 2.5 cm long…………………………………………..…**18. D. globosus**

36. Tomentum on petiole, leaf blade and leaf bud sparse, greyish brown……………………
………………………………………………………………..**5. D. caudiferus** (in part)
Tomentum on petiole, leaf blade and leaf bud yellowish, buff, golden, or dark or rust-brown; dense at least on leaf bud……………………………………………………..…37

37. Leaf lateral veins at least 16 pairs…………………………………………………..…38
Leaf lateral veins at most 14 pairs…………………………………………………..…39

38. Leaf bud densely pale yellowish long-tomentose…………**29. D. oblongifolius** (in part)
Leaf bud densely minutely greyish-buff pubescent…………………..…**24. D. kunstleri**

39. Twigs compressed……………………………………………..…**31. D. pachyphyllus**
Twigs terete……………………………………………………………………………40

40. Leaf bud slender, more or less falcate, with apical tuft, tomentum otherwise very short ……………………………………………………………………………………………41
Leaf bud ellipsoid-ovoid to broadly ovoid, stout, densely buff or rust-brown long-tomentose……………………………………………………………………………………44

41. Leaf bud minutely golden-brown pubescent, glistening due to the presence of minute radiating shiny stellate hairs; leaf blade broadly elliptic-ovate, drying pinkish brown……………………………………………………………………**39. D. verrucosus**
Leaf bud evenly greyish-buff pubescent, the hairs inclined towards the apex; leaf blade elliptic, lanceolate, or obovate, drying pale rust-brown or orange-brown……………....42

42. Leaf blade broadly elliptic-obovate, prominently corrugated…**37. D. tempehes** (in part)
Leaf blade narrowly elliptic, flat………………………………………………………43

43. Leaf lateral veins at least 10 pairs……………….**4. D. caudatus** (subsp. **penangianus**)
Leaf lateral veins at most 10 pairs……………………………..…**14. D. fagineus** (in part)

44. Leaf bud densely buff long-tomentose………………………**1. D. acutangulus** (in part)
Leaf bud golden- to rust-tomentose or pale fulvous-hirsute…………………………..…45

45. Leaf lateral veins at least 12 pairs; leaf blade thinly coriaceous…..**32. D. palembanicus**
Leaf lateral veins at most 12 pairs; leaf blade coriaceous……………………………..…46

46. Leaf bud rust- to dark-brown tomentose. Trees of *kerangas* forest…….**3. D. borneensis**
Leaf bud pale fulvous-hirsute. Trees of mixed dipterocarp forest, especially on flat land ……………………………………………………………………..**36. D. sublamellatus**

1. **Dipterocarpus acutangulus** Vesque

(Latin, *angulus* = angle, *acutus* = sharp; the ribs of fruit calyx tube)

C. R. Ac. Sci. Paris, 78 (1874) 626; Slooten *op. cit.* (1927) 321, Reinwardtia 5 (1961) 457; Masamune, EPB (1942) 485; Symington *op. cit.* (1943) 166; Browne *op. cit.* 107; Ashton *op. cit.* (1963) 240, *op. cit.* (1964) 22, *op. cit.* (1968) 11, *op. cit.* (1982) 322; Meijer & Wood *op. cit.* 235; Burgess *op. cit.* 99; Anderson *op. cit.* (1980) 111; PROSEA *op. cit.* 172; Coode *et al.* (eds.) *op. cit.* 66; Newman *et al. op. cit.* 76. **Type:** *Beccari PB 2913*, Borneo (holotype FI; isotype K). **Synonyms:** *Dipterocarpus tawaensis* Slooten *op. cit.* (1927) 313, Merrill, PEB (1929) 201, Masamune *op. cit.* 488; *D. helicopteryx* Slooten, Bull. Jard. Bot. Buitenz. 3, 16 (1940) 441.

Emergent tree, to 60 m tall, to 1.2 m diameter. **Bark** becoming pale buff-brown, flaky. *Young parts densely evenly buff-pubescent*, *persistent only on leaf bud*, *stipules and ovary*. **Twigs** *c. 3 mm diameter apically*, *terete*, with somewhat swollen nodes. *Leaf buds short*, *stout*, broadly ovoid, to 8 × 5 mm, *buff-pubescent but occasionally glabrous and drying black*. **Stipules** to 5 × 0.8 cm. **Leaves** coriaceous, drying yellowish brown, glabrous or almost so below; blade elliptic to ovate, 7–10 × 3–6 cm, base obtuse or cuneate, margin sinuate, apex with tapering acumen to 1 cm long; *lateral veins 7–12 pairs*, stout below; *petiole 1.5–2.5 cm long*, *to 2 mm diameter*. **Inflorescences**: rachis axillary, slender, terete, glabrous, to 6 cm long, *c.* 1.5 mm diameter. **Flower:** buds spindle-shaped, to 1.5 × 0.5 cm; calyx tube narrowly obconical, narrowly 5-winged, shorter sepal lobes vestigial; stamens 15, anthers *c.* 6 mm long including appendages, narrowly deltoid; style exceeding anthers, slender glabrous. **Fruits:** *calyx tube globose*, *to 2.5 cm diameter*, *glabrescent*, *base* *becoming impressed*, *5-ribbed from base to apex*; 2 longer calyx lobes to 10 × 2.5 cm, 3 shorter ones deltoid, to 0.5 × 0.5 cm, revolute.

Vernacular names. Sabah—*keruing merkah* (preferred name). Sarawak—*keruing beludu* (preferred name).

Distribution. Peninsular Malaysia (rare) and Borneo except southeastern parts. Widespread in Sabah and known from Beaufort, Kinabatangan, Kota Kinabalu, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Semporna, Sipitang, and Tawau districts (e.g., *SAN 15169*, *SAN 16183*, *SAN 18477*, *SAN 21408*, and *SAN 90469*) and in Sarawak from Bintulu, Kapit, Kuching, Lawas, Lundu, Miri, and Serian districts (e.g., *S 13372*, *S 15145*, *S 22062*, *S 23800*, and *S 46477*). Also occurring in Brunei (e.g., *BRUN 927*, *BRUN 985*, *BRUN 2637*, *BRUN 3348*, and *S 1669*) and Kalimantan (e.g., *bb. 10012* and *bb. 19811*).

Ecology. Locally common in mixed dipterocarp forest on yellow sandy and sandy clay soils, at altitudes below 400 m. Scattered also on inland shale and sandstone ridges, at altitudes to 1000 m. Well represented in Sarawak parks system and in Sepilok FR; elsewhere vulnerable.

Notes. A variable species in leaf size and texture; the leaf being larger and more coriaceous in W Sarawak than elsewhere where it may be difficult to distinguish from *D. globosus* (*q.v.*). The Kinabalu endemic, *D. ochraceus*, appears to be descended from it.

2. **Dipterocarpus applanatus** Slooten Fig. 5.

(Latin, *applanatus* = flattened out; the leaf blade)

Bull. Jard. Bot. Buitenz. 3, 16 (1940) 443; Masamune *op. cit.* 485; Meijer & Wood *op. cit.* 237; Burgess *op. cit.* 99; Ashton *op. cit.* (1968) 11, *op. cit.* (1982) 310; Anderson *op. cit.* (1980) 111; PROSEA *op. cit.* 173; Newman *et al. op. cit.* 78. **Type:** *Puasa SAN 1720*, Borneo, Sabah, Sandakan district (holotype K).

Emergent tree, to 50 m tall, to 1.5 m diameter; buttresses prominent, to 3 m tall. **Bark** orange- and greenish-brown mottled, thinly flaky. *Leaf bud and stipule outside persistently evenly buff-tomentose*; *young twig*, *inside of stipules and base of inflorescence shortly buff-pubescent.* **Twigs** *to 11 mm diameter apically*, *stout*, *terete*, pale but for slightly depressed dark stipule scars. Leaf buds broadly ellipsoid to falcate, to 27 × 15 mm. **Stipules** to 5 × 2 cm. **Leaves** thickly coriaceous, somewhat undulate, *glabrous below*; blade broadly elliptic, 12–30 × 9–20 cm, base obtuse to subcordate, apex shortly abruptly acuminate; *lateral veins 11–15 pairs*, prominent below; intercostal venation remote, subreticulate; *petiole to 6 cm long*, *to 4 mm diameter*, *stout.* **Inflorescences:** axillary or ramiflorous, glabrous, to 12 cm long; rachis stout, unbranched, bearing to 5 flowers. **Flower** large, ellipsoid, to 4 × 1.5 cm; calyx tube ellipsoid, smooth, sepal lobes subequal, elliptic-oblong; stamens *c.* 50, anthers linear-lorate, *c.* 1.8 mm long with fleshy tapering connective appendage. **Fruits:** *calyx tube ovoid*, to 5 × 4.5 cm, glabrous, *with 5*, *to 8 mm wide sharp ribs most prominent distally*, *sometimes absent in basal half*; 2 major calyx lobes to 19 × 4.5 cm, 3 minor ones suborbicular, to 1 × 1 cm, revolute.

Vernacular names. Sabah—*keruing daun besar* (preferred name). Sarawak—*keruing arong* (preferred name).

Distribution. Endemic in Borneo with a disjunct range. In Sabah known from Kinabatangan, Sandakan and Tawau districts (e.g., *FMS 38844*, *SAN 17160*, *SAN 18752*, *SAN 19677*, and *SAN 39151*) and in Sarawak from Kuching and Serian districts (e.g., *S 8587*, *S 9489*, *S 15201*, *S 41016*, and *S 41017*). Also occurring in SE Kalimantan (e.g., *bb. 11675*, *bb. 18135* and *bb. 26595*).

Ecology. Local but sometimes abundant in mixed dipterocarp forest, on flat land, low hills and sometimes rocky slopes, on yellow sandy soils especially near the coast, at altitudes below 200 m. Vulnerable.

3. **Dipterocarpus borneensis** Slooten
(of Borneo)

Bull. Jard. Bot. Buitenz. 3, 16 (1940) 445; Masamune *op. cit.* 485; Browne *op. cit.* 107; Ashton *op. cit.* (1964) 24, *op. cit.* (1968) 11, *op. cit.* (1982) 319; Anderson *op. cit.* (1980) 111; PROSEA *op. cit.* 174; Coode *et al.* (eds.) *op. cit.* 67; Newman *et al. op. cit.* 79. **Type:** *bb. 26417*, Borneo, Kalimantan, Pepas, Muara Tewe (holotype BO; isotype KEP).

Main canopy or shortly emergent tree, to 30 m tall, to 70 cm diameter, often with crooked trunk. **Bark** pale orange-brown to greyish brown, narrowly thinly flaking, becoming shaggy. *Young parts sparsely rust-brown pubescent*; *indumentum more or less persistent on ovary*, *leaf venation below and petiole*, *and dense and persistent on leaf bud and stipule outside.* **Twigs** *3–5 mm diameter apically*, *terete*. *Leaf buds ovoid*, to 7 × 3 mm. **Stipules** to 4 × 0.5 cm. **Leaves** *coriaceous*, drying greyish brown, *sparsely pubescent to glabrous below*; blade broadly ovate to elliptic, 7–12 × 3–7 cm, base obtuse or broadly cuneate, margin frequently wavy towards apex, apex with tapering acumen to 0.8 cm long; *lateral veins 9–12 pairs*, slender but prominent below; *petiole 1.5–2.5 cm long*, *to 2 mm diameter*, *slender*. **Inflorescences** to 6 cm long, singly or rarely doubly branched. **Flower:** buds to 4 × 1 cm; *stamens c. 25*, anthers short, narrowly sagittate. **Fruits:** *calyx tube narrowly obovoid to ellipsoid*, *to 1.5 × 1 cm*, *glabrous*, tapering at each end, *with 5*, *c. 1 mm wide flanges in the distal half*; 2 major calyx lobes to 7.5 × 1.8 cm, 3 minor ones *c.* 0.5 × 0.4 cm, revolute and recurved.

Vernacular names. Sarawak—*keruing sindor* (preferred name), *resak kerangas* (Iban).

Distribution. Sumatra and Borneo. In Borneo, common and widespread in Sarawak and recorded from Bintulu, Kuching, Lawas, Lundu, Marudi, Samarahan, Serian, Sibu, and Sri Aman districts (e.g., *S 9855*, *S 12492*, *S 13732*, *S 16222*, and *S 16236*) but absent in Sabah. Also occurring in Brunei (e.g., *BRUN 648*, *BRUN 830*, *FMS 34572*, *Niga 141*, and *S 2236*) and W and SE Kalimantan (e.g., *bb. 11344*, *bb. 16472*, *bb. 32384*, and *Kostermans 6888*).

Ecology. Locally abundant in *kerangas* forest, usually on deep podsol soils, on raised beaches and plateaux, at altitudes to 400 m; locally also on shallow peat. Common in Bako NP and occurring in Mulu NP, but vulnerable elsewhere owing to habitat destruction.

4. **Dipterocarpus caudatus** Foxw.
(Latin, *caudatus* = tailed; the narrow acumen of the leaf apex)

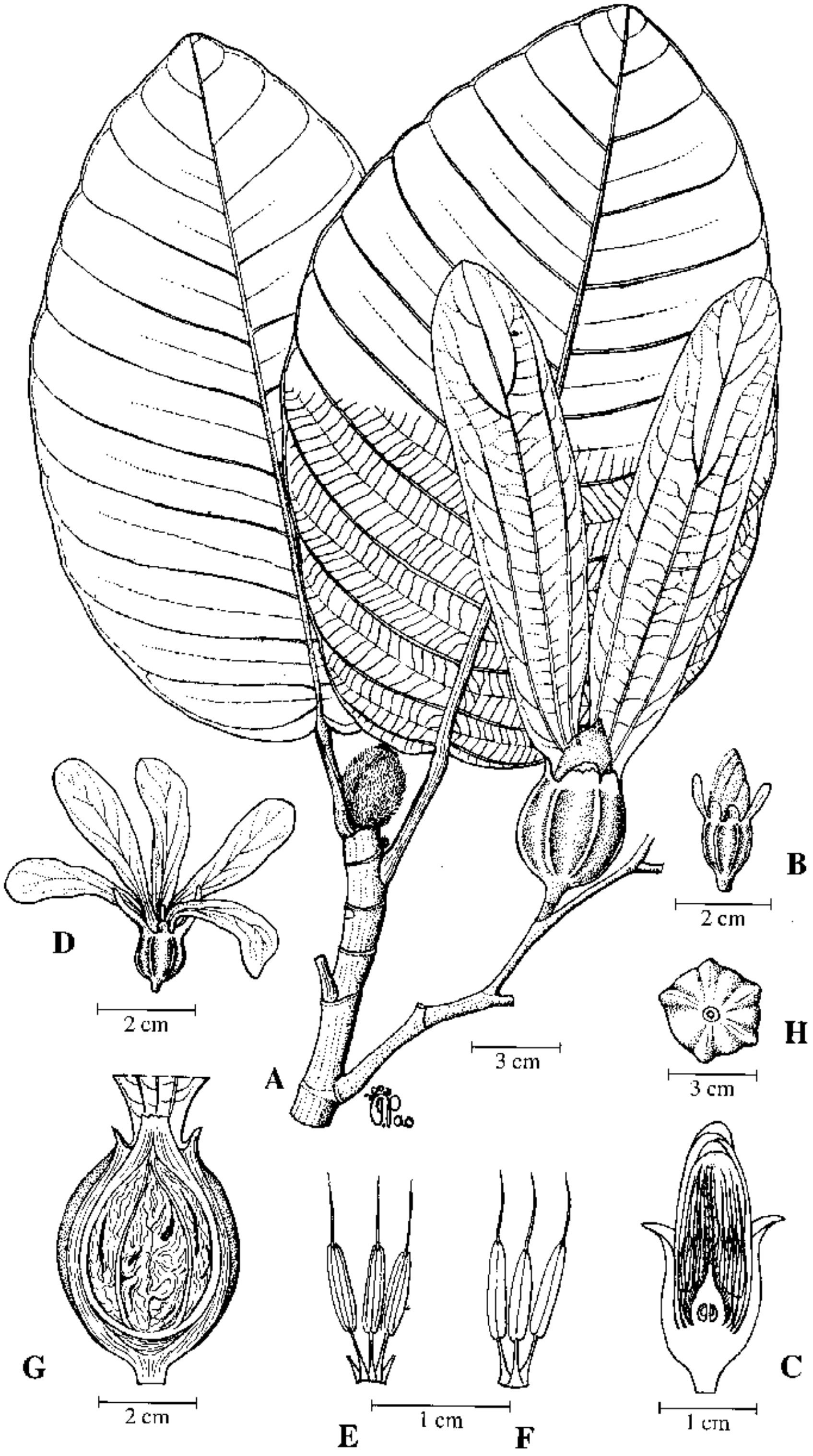

Fig. 5. *Dipterocarpus applanatus*. A, fruiting leafy twig; B, flower bud; C, longitudinal section of flower bud; D, open flower; E, adaxial view of stamens; F, abaxial view of stamens; G, longitudinal section of fruit; H, basal view of fruit calyx tube. (A and H from *SAN 39151*, B and D–F from *S 41017*, C from *SAN 35868*, G from *FMS 35395*.)

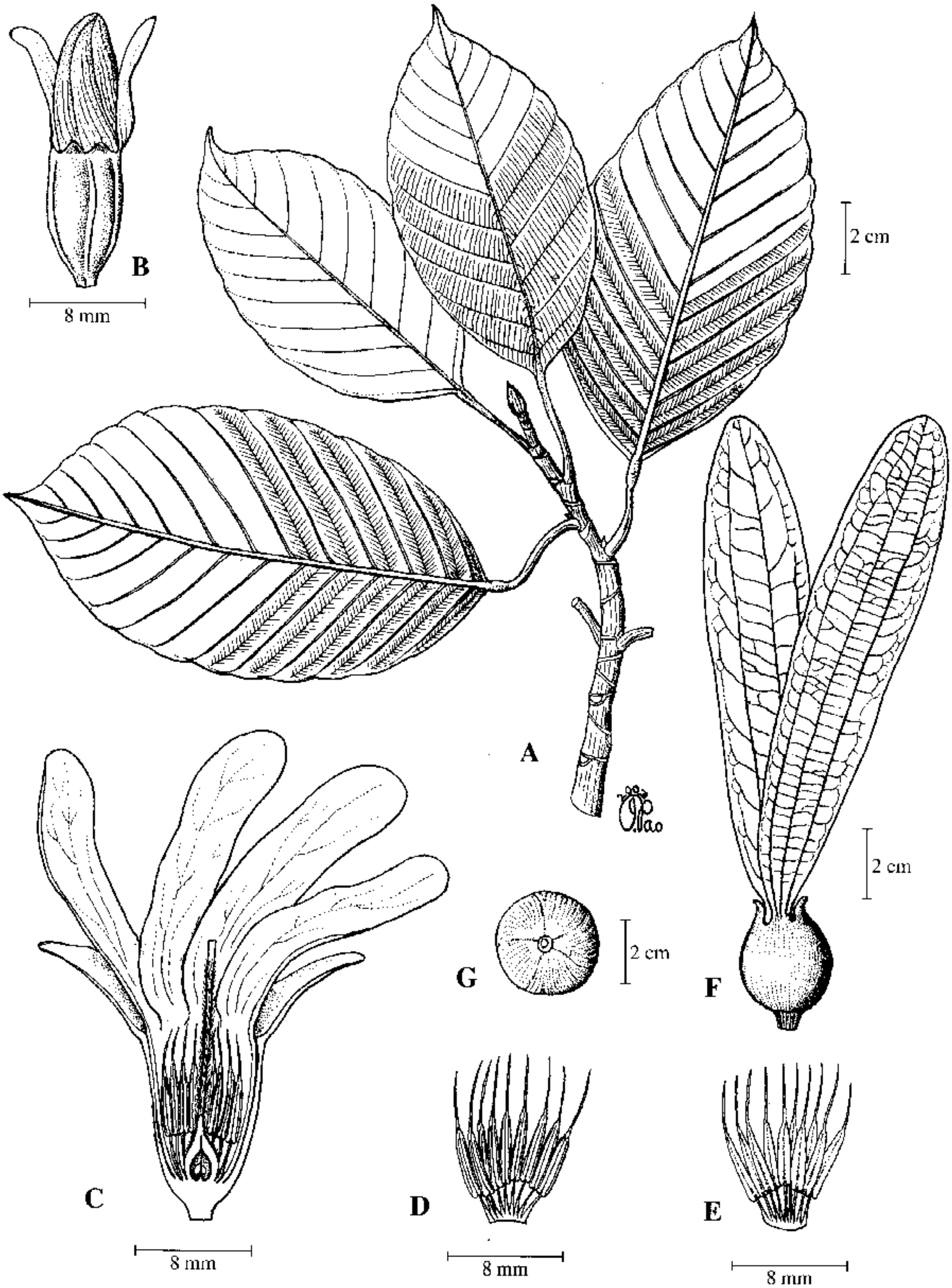

Fig. 6. *Dipterocarpus caudiferus*. A, leafy twig; B, flower bud; C, longitudinal section of open flower; D, adaxial view of stamens; E, abaxial view of stamens; F, fruit; G, basal view of fruit calyx tube. (A and F–G from *SAN 16847*, B from *FMS 38786*, C–E from *SAN 16335*.)

Philip. J. Sci. 13 (1918) Bot. 177, Philip. J. Sci. 67 (1938) Bot. 256; Ashton *op. cit.* (1978) 8, *op. cit.* (1982) 305. **Lectotype** (Ashton, 1978)**:** *Alvarez FB 21193*, the Philippines, Luzon, Barrio Hibatac, Camarines (hololectotype K).

Distribution. Sumatra, Peninsular Malaysia, Singapore, Borneo, and the Philippines.

Notes. Two subspecies, viz. subsp. *caudatus* and subsp. *penangianus* are recognised. Of these, only subsp. *penangianus* occurs in Borneo.

subsp. **penangianus** (Foxw.) P.S.Ashton
(of Pulau Pinang, Peninsular Malaysia)

Gard. Bull. Sing. 31 (1978) 8, *op. cit.* (1982) 305; PROSEA *op. cit.* 174; Coode *et al.* (eds.) *op. cit.* 68; Newman *et al. op. cit.* 80. **Basionym:** *Dipterocarpus penangianus* Foxw., *op. cit.* (1932) 72, Symington *op. cit.* (1943) 185, Ashton *op. cit.* (1964) 43. **Type:** *Haniff SFN 3484*, Peninsular Malaysia, Penang, Mt. Olivia (holotype SING; isotype K).

Emergent tree, to 50 m tall, to 1.2 m diameter. **Bark** orange-red, becoming pale orange-grey when exposed, irregularly flaky. *Young parts shortly sparsely fugaceous buff-puberulent*; *ovary*, *leaf bud and stipule outside densely persistently buff-pubescent.* **Twigs** *terete*, *1–3 mm diameter apically*, *slender*. *Leaf buds linear-falcate*, to 17 × 3 mm, *tufted at apex*. **Stipules** *c.* 3.5 × 0.5 cm. **Leaves** *drying pale orange-brown*, shiny above, *glabrous or almost so below, flat*; *blade elliptic-lanceolate to elliptic-oblanceolate*, 7–11 × 3.5–4 cm, base cuneate, margin frequently wavy distally, apex prominently narrowly acuminate, acumen to 2 cm long; *lateral veins 10–12 pairs*, well-spaced, hardly raised below; *petiole 1.5–2.5 cm long*, *to 1 mm diameter*, *slender*. **Inflorescences** to 12 cm long, slightly compressed. **Flowers:** buds to 3 × 0.8 cm; *stamens c. 30*, anthers short, linear. **Fruits:** *calyx tube to 2 cm diameter*, obturbinate and tapering into the short pedicel, *smooth*; *2 major calyx lobes to 14 × 3 cm*, *3 minor ones to 0.8 × 0.4 cm*, *becoming recurved and revolute.*

Vernacular name. Sarawak—*keruing gasing* (preferred name).

Distribution. Sumatra (Karimun, Musala), coastal Peninsular Malaysia, Singapore, and Borneo. In Sabah recorded from Beaufort district (e.g., *SAN 15231*) and in Sarawak from Limbang, Marudi and Serian districts (e.g., *S 15204*, *S 23310*, *S 32208*, and *S 32329*). Also occurring in Brunei (e.g., *BRUN 5724*, *BRUN 5734*, *FMS 48205*, *KEP 80125*, and *S 1674*), but not known in Kalimantan.

Ecology. Local but common where it occurs, in mixed dipterocarp forests on dry ridges, at altitudes below 400 m, especially but not exclusively near the coast; formerly most abundant along the coastal hills on sandy soils, but also on the acid volcanic rocks of Ulu Arip, Balingian, and on high dacite ridges in the Hose mountains and Usun Apau in Sarawak. Endangered by land conversion.

5. **Dipterocarpus caudiferus** Merr. Fig. 6.

(Latin, *cauda* = a tail, *ferre* = to bear; the narrow acumen of leaf apex)

Philip. J. Sci. 29 (1926) 398; Slooten *op. cit.* (1927) 302, *op. cit.* (1961) 459; Masamune *op. cit.* 485; Browne *op. cit.* 107; Ashton *op. cit.* (1963) 236, *op. cit.* (1964) 25, *op. cit.* (1968) 11, *op. cit.* (1982) 299; Meijer & Wood *op. cit.* 239; Burgess *op. cit.* 99; Anderson *op. cit.* (1980) 111; PROSEA *op. cit.*

175; Coode *et al.* (eds.) *op. cit.* 69; Newman *et al. op. cit.* 81. **Type:** *Castro & Melegrito 1709*, Borneo, Banguey Is. (holotype K). **Synonyms:** *Dipterocarpus macrorrhinus* Slooten *op. cit.* (1927) 300; *D. kutaianus* Slooten *op. cit.* (1940) 437, Masamune *op. cit.* 483.

Immense emergent tree, to 65 m tall, to 1.5 m diameter, with tall columnar bole and prominent buttresses to 3.5 m tall. **Bark** pale pinkish grey, appearing smooth but thinly regularly vertically flaked. *Young parts more or less caducous sparsely silky greyish brown hispid*, *persistent on young trees.* **Twigs** *c. 5 mm diameter apically*, terete. *Leaf buds sparsely greyish brown hispid or glabrous*, *lanceolate*, *somewhat compressed*, to 25 × 3 mm, *occasionally drying black*. **Stipules** *c.* 7 cm long. **Leaves** *thinly coriaceous*, *hardly to prominently corrugated*, drying greyish brown, *glabrous or sparsely hispid with greyish brown hairs to 2 mm long*; *blade narrowly elliptic*, 11–20 × 5–15 cm, base obtuse or cuneate, margin frequently sinuate distally, apex with slender acumen to 0.8 cm long; *lateral veins 12–20 pairs*, *dense*, slender but prominent below; *intercostal venation slender*, *densely*, *regularly scalariform*; *petiole 3–4 cm long*, *slender*, *at most to 2 mm diameter*, persistently hispid on the knee. **Inflorescences** to 15 cm long, simple or singly branched. **Flowers:** buds to 5 × 0.8 cm; *stamens c. 25*, anthers narrowly oblong, tapering. **Fruits:** *calyx tube* globose or obturbinate, to 3.5 cm diameter, tapering into pedicel, *smooth*; *2 major calyx lobes to 17 × 3 cm*, *3 minor ones deltoid*, *to 0.6 × 0.7 cm*, *hardly recurved.*

Vernacular name. Sabah and Sarawak—*keruing putih* (preferred name).

Distribution. Endemic in Borneo, absent from south and southwest parts. Common throughout Sabah and recorded from most districts (e.g., *SAN 16335*, *SAN 17003*, *SAN 18603*, *SAN 19416*, *SAN 20949*, *SAN 27363*, and *SAN 134504*) and throughout Sarawak and recorded from Bau, Kapit, Kuching, Lawas, Limbang, Lundu, Marudi, Miri, and Tatau districts (e.g., *S 1812*, *S 10159*, *S 13779*, *S 15504*, and *S 29681*). Also occurring in Brunei (e.g., *BRUN 331*, *BRUN* 2639, *BRUN* 3025, and *S 1662*) and E Kalimantan (e.g., *Kostermans 6630*, *Kostermans 13277*, *Kostermans 13960*, and *Kostermans 13978*).

Ecology. Locally common in mixed dipterocarp forest, at altitudes below 800 m, on well-structured clay soils; frequent on other clay soils, on shale, volcanic rocks and granodiorite. Common in G. Gading NP and locally so in Mulu NP; probably not endangered.

6. **Dipterocarpus confertus** Slooten

(Latin, *confertus* = crammed together; perhaps referring to the indumentum)

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 322, Bull. Jard. Bot. Buitenz. 3, 17 (1941) 104, *op. cit.* (1961) 460; Merrill *op. cit.* (1929) 201; Foxworthy *op. cit.* (1932) 62; Masamune *op. cit.* 485; Browne *op. cit.* 108; Ashton *op. cit.* (1964) 26, *op. cit.* (1968) 12, *op. cit.* (1982) 315; Meijer & Wood *op. cit.* 242; Burgess *op. cit.* 99; Anderson *op. cit.* (1980) 111; PROSEA *op. cit.* 175; Kessler & Sidiyasa *op. cit.* 92; Coode *et al.* (eds.) *op. cit.* 68; Newman *et al. op. cit.* 82. **Lectotype** (Slooten, 1941)**:** *Elmer 21548*, Borneo, Sabah, Tawau district (hololectotype K; isolectotypes L, NY).

Medium-sized emergent tree, to 50 m tall, to 1.5 m diameter; bole rather short; crown fresh green from below, large-leafed and diffuse. **Bark** regularly vertically cracked and flaky. *Twigs at first*, *buds*, *stipule outside*, *petiole*, *midrib above*, *venation below*, *ovary*, *and calyx persistently long pale-fulvous tufted-hispid*; *leaf surface persistently or caducously so.*

Twigs to 10 mm diameter apically, stout. Leaf buds to 20 × 17 mm, large, broadly ovoid, obtuse or subacute. **Stipules** broadly ovate, *c.* 5 × 5 cm. **Leaves** *concave*, somewhat bullate, chartaceous, drying pale honey-brown and quickly decomposing; *blade broadly obovate to suborbicular*, *(18–)22–35* × *(14–)16–22 cm*, base obtuse, generally subpeltate, apex obtuse or shortly acuminate; *lateral veins 9–12 pairs*, well-spaced; *petiole 5–6 cm long*, prominently articulated. **Inflorescences** to 7 cm long, simple or singly branched. **Flowers:** buds to 4 × 1 cm; stamens *c.* 25, anthers narrowly oblong, tapering. **Fruits:** *calyx tube narrowly obovoid*, *c. 3* × *1.7 cm*, tapering into pedicel, *5-ribbed*; 2 longer calyx lobes to 14 × 3 cm, glabrous within, 3 minor ones oblong, to 1.7 × 0.7 cm, recurved distally.

Vernacular name. Sabah and Sarawak—*keruing kobis* (preferred name).

Distribution. Endemic in Borneo; widespread except in the southwestern parts. Common in Sabah and known from Kinabatangan, Kudat, Ranau, Sandakan, and Sipitang districts (e.g., *SAN 15192*, *SAN 16372*, *SAN 16545*, *SAN A 3065*, and *SAN A 4676*) but less common in Sarawak and known from Kapit, Kuching, Lawas, Limbang, Miri, and Samarahan districts (e.g., *S 1830*, *S 13473*, *S 15762*, *S 19857*, *S 32353*, and *S 69176*). Also occurring in Brunei (e.g., *BRUN 441*, *FMS 30518* and *FMS 37111*) and E Kalimantan (e.g., *bb. 19283*, *bb. 24014*, *Kostermans 6212*, *Kostermans 6707*, and *Kostermans 7278*).

Ecology. Locally frequent in mixed dipterocarp forest on leached yellow clay soils, especially on undulating lands and low ridges, occasionally at altitudes to 800 m. Vulnerable.

7. **Dipterocarpus conformis** Slooten

(Latin, *conformis* = of a similar form; alluding the great similarity in vegetative characters with two other large-leafed species, *viz. D. concavus* and *D. confertus*)

Bull. Jard. Bot. Buitenz. 3, 17 (1941) 102. **Type:** *bb. 29177*, Sumatra, Aceh Province, Alur Buaya, Langsa (holotype BO).

Distribution. Sumatra and Borneo.

Notes. Two subspecies are recognised, *viz*. subsp. *conformis* which is confined to Aceh, N Sumatra and subsp. *borneensis* which is endemic in Borneo.

subsp. **borneensis** P.S.Ashton

(of Borneo)

Gard. Bull. Sing. 20 (1963) 28, *op. cit.* (1964) 28, *op. cit.* (1968) 12, *op. cit.* (1982) 321; Meijer & Wood *op. cit.* 244; Burgess *op. cit.* 99; Anderson *op. cit.* (1980) 111; PROSEA *op. cit.* 176; Coode *et al.* (eds.) *op. cit.* 68; Newman *et al. op. cit.* 84. **Type:** *G.H.S Wood SAN 15102*, Borneo, Sabah, Sipitang district, Pangi (holotype L; isotypes KEP, SAN).

Medium-sized emergent tree, to 50 m tall, to 1.2 m diameter; crown densely symmetrical, pale greyish green from below. **Bark** becoming unevenly irregularly flaky. *Young parts densely pale pinkish brown velutinous, persistent except for leaf upper surface*. **Twigs** *c.* 3 mm diameter apically. Leaf buds ovoid, *c.* 8 × 4 mm, obtuse. **Stipules** ovate, *c.* 1.5 × 0.6

cm, concave. **Leaves** *thinly coriaceous*, *more or less corrugated but not concave*; *blade obovate*, *9–12 × 5–7 cm*, base obtuse to subcordate, narrowly subpeltate, apex with acumen 0.4–0.8 cm long; *lateral veins 15–18 pairs*, slender but prominent and dense below; *petiole 1.7–2.5 cm long*, slender, rugose on drying. **Inflorescences** to 6 cm long, terminal or axillary, unbranched or singly branched. **Flowers:** buds to 3 × 0.8 cm; stamens *c.* 30, anther linear, short. **Fruits:** *calyx tube ellipsoid*, *c. 2.5 × 2 cm*, neck narrowed to 1.2 cm diameter, *persistently velutinous*, *with 5*, *c. 3 mm wide rigid incrassate flanges from base to apex*; 2 major calyx lobes to 10 × 2 cm, 3 minor ones ovate, to 0.8 × 0.8 cm, revolute.

Vernacular name. Sabah and Sarawak—*keruing beludu kuning* (preferred name).

Distribution. Endemic in Borneo. Known in Sabah from Beaufort and Labuk Sugut districts (e.g., *SAN 15102*, *SAN 27582* and *SAN 97592*) and in Sarawak from Bintulu, Kapit, Lawas, and Limbang districts (e.g., *S 14358* and *S 32390*). Also occurring in Brunei (e.g., *BRUN 738*, *BRUN 2602* and *BRUN 5673*).

Ecology. Rare in mixed dipterocarp forest on clay soils over shale, generally in steep country, at altitudes below 800 m. Vulnerable, possibly endangered.

8. **Dipterocarpus coriaceus** Slooten

(Latin, *coriaceus* = with leathery texture; the leaf blade)

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 331; Masamune *op. cit.* 485; Symington *op. cit.* (1943) 171; Browne *op. cit.* 108; Anderson, Gard. Bull. Sing. 20 (1963) 157, *op. cit.* (1980) 111; Ashton *op. cit.* (1968) 12, *op. cit.* (1982) 324; Newman *et al. op. cit.* 85. **Type:** *bb. 8154*, Borneo, SE Kalimantan, Tawai Baru, near Kuala Kapuas (holotype BO; isotype L).

Medium-sized emergent tree, to 40 m tall, to 1 m diameter; crown irregular, diffuse. **Bark** irregularly flaky. *Leaf under surface*, *petiole and twig shortly densely evenly persistently pinkish brown pubescent*; *leaf bud*, *stipule outside*, *midrib below*, *twig and petiole of young tree at first densely hairy with hairs to 2 mm long*. **Twigs** *c.* 10 mm diameter apically, stout. Leaf buds ovoid-deltoid *c.* 25 × 10 mm. **Stipules** narrowly ovate, *c.* 4 × 2 cm. **Leaves** *thickly coriaceous*, *prominently corrugated*; *blade broadly elliptic-ovate*, *16–21 × 10–15 cm*, base obtuse to broadly cuneate, *apex subacute*; *lateral veins 14–16 pairs*, prominent below, sunken above; intercostal venation obscure; *petiole 4.5–6 cm long*, stout, prominently geniculate. **Inflorescences** and **flowers** unknown. **Fruits:** pedicels to 7 mm long, prominent; *calyx tube broadly ovoid, to 3 × 2.2 cm*, *glabrescent*, *with 5 stout flanges or ribs to 5 mm wide*, *tapering abruptly apically and gradually towards base*; 2 major calyx lobes to 14 × 2.5 cm, 3 minor ones elliptic, to 1.2 × 0.6 cm, hardly revolute.

Vernacular name. Sarawak—*keruing paya* (preferred name).

Distribution. E Sumatra, C Peninsular Malaysia, S and W Borneo. In Borneo, known in Sarawak from Kuching, Lundu, Mukah, Samarahan, Sibu, and Sri Aman districts (e.g., *S 555*, *S 556*, *S 9820*, and *S 14584*) and W and SE Kalimantan (e.g., *bb. 7450*, *bb. 8154* and *bb. 9442*).

Ecology. Very local; as scattered individuals or semi-gregarious populations in mixed peat swamp forest on the inner margins. Critically endangered.

9. **Dipterocarpus costulatus** Slooten

(Latin, *costulatus* = slightly-ribbed; the leaf blade)

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 315, *op. cit.* (1941) 105; Masamune *op. cit.* 486; Symington *op. cit.* (1943) 174; Browne *op. cit.* 108; Meijer & Wood *op. cit.* 244; Ashton *op. cit.* (1968) 112, *op. cit.* (1982) 310; PROSEA *op. cit.* 177; Anderson *op. cit.* (1980) 112; Newman *et al. op. cit.* 87. **Type:** *Sahak CF 1908*, Peninsular Malaysia, Negeri Sembilan, Kuala Pilah, Senaling Inas FR (holotype KEP).

Emergent tree, to 50 m tall, to 1.2 m diameter. **Bark** pale greenish cream, patchily peeling but sustaining an overall smooth appearance. *Parts glabrous but for densely shortly buff-pubescent inner surface of stipules*, *bud scales*, *and ovary*. **Twigs** *c.* 7 mm diameter apically, at first somewhat compressed. *Leaf buds falcate*, to 30 × 6 mm, *drying black*. **Stipules** lorate, *c.* 16 × 2 cm. **Leaves** *thickly coriaceous*, *corrugated*; *blade broadly elliptic to ovate*, *12–20 × 7–14 cm*, base cuneate, apex obtuse or shortly acuminate; *lateral veins 11–14 pairs*, prominent below; *petiole 3–6 cm long*. **Inflorescences** to 20 cm long, once branched. **Flowers:** buds to 3 × 5 cm; stamens *c.* 24, anther linear. **Fruits:** pedicels to 6 mm long, prominent; *calyx tube subglobose*, *to 1.5 × 2 cm*, *with 5 prominent flange-like median tubercles*; 2 major calyx lobes to 20 × 4 cm, 3 minor ones suborbicular, to 0.7 × 0.6 cm, revolute.

Vernacular name. Sabah and Sarawak—*keruing kipas* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah known from Tawau district, including Sebatik Is. (e.g., *FMS 38859*, *SAN 18470*, *SAN 18559*, *SAN 19643*, and *SAN 25026*) and in Sarawak from Kapit, Kuching and Lundu districts (e.g., *S 4798*, *S 15422*, *S 21451*, *S 23805*, and *S 43192*). Also occurring in W Kalimantan (e.g., *bb. 6271*).

Ecology. Common in Peninsular Malaysia but very local and uncommon in Sabah and Sarawak, on occasionally flooded alluvium and in the ecotone between mixed dipterocarp forest and *kerangas* forest, on sandy soils and shallow peat, at altitudes below 200 m. Highly vulnerable owing to forest conversion.

10. **Dipterocarpus crinitus** Dyer

(Latin, *crinitus* = having tufts of long weak hairs; the living plant parts)

Fl. Brit. Ind. 1 (Jan. 1874) 296, J. Bot. 12 (1874) 103 & 154; King *op. cit.* 90; Merrill, EB (1921) 398; Ridley *op. cit.* (1922) 214; Slooten *op. cit.* (1927) 288; Masamune *op. cit.* 486; Foxworthy *op. cit.* (1932) 66; Symington *op. cit.* (1943) 175; Browne *op. cit.* 108; Ashton *op. cit.* (1964) 29, *op. cit.* (1968) 13, *op. cit.* (1982) 299; Meijer & Wood *op. cit.* 246; Burgess *op. cit.* 99; Anderson *op. cit.* (1980) 112; PROSEA *op. cit.* 177; Coode *et al.* (eds.) *op. cit.* 68; Newman *et al. op. cit.* 88. **Type:** *Maingay 196*, Peninsular Malaysia, Malacca (holotype K). **Synonym:** *Dipterocarpus hirtus* Vesque *op. cit.* (March 1874) 627.

Large emergent tree, to 60 m tall, to 2 m diameter; bole frequently misshapen; crown golden-green from below. **Bark** weathering pale greyish pink, irregularly patchily flaky; inner bark relatively thick, cream-coloured. *Plant parts tufted-setose with golden-brown* *bristle-like hairs c. 3 mm long*, *shorter on leaf blade*; *leaf upper surface fugaceous pubescent*. **Twigs** *c.* 3 mm diameter apically. Leaf buds oblong, *c.* 5 × 2 mm, obtuse. **Stipules** lanceolate, *c.* 3 × 0.5 cm. **Leaves** chartaceous, *not concave*, *persistently folded between the veins*; *blade elliptic*, *6–9 × 3–5 cm*, base obtuse, *margin revolute*, *apex obtuse or shortly acuminate*; *lateral veins 13–15 pairs*, slender but prominent below; *petiole 1.5–2.5 cm long*, slender. **Inflorescences** to 12 cm long, singly branched, terminal or axillary. **Flowers:** *stamens 15*, anthers linear. **Fruits** *subsessile*; *calyx tube ellipsoid*, *to 1.8 × 0.8 cm*, *smooth*, 2 major calyx lobes to 8 × 1.5 cm, 3 minor ones deltoid, *c.* 0.3 cm long, acute.

Vernacular name. Sabah and Sarawak—*keruing mempelas* (preferred name).

Distribution. Peninsular Thailand, Sumatra, Peninsular Malaysia, and Borneo. In Sabah recorded from Sipitang and Tawau districts (e.g., *SAN 15171*, *SAN 15287*, *SAN 26894*, and *SAN A 3296*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lawas, Lundu, Marudi, Miri, and Serian districts (e.g., *S 9478*, *S 10121*, *S 15125*, *S 16629*, and *S 23897*). Also occurring in Brunei (e.g., *BRUN 3137*, *BRUN 3268* and *BRUN 5043*) and W, C and SE Kalimantan (e.g., *Amiril P6. 247*, *bb. 27768*, *bb. 31415*, and *Kostermans 12765*).

Ecology. Common in mixed dipterocarp forest on sandy clay soils, at altitudes to 800 m. This species flowers sporadically outside mass flowering events, but seeds have high infertility though juveniles are common. Well represented in the parks system; vulnerable elsewhere.

11. **Dipterocarpus cuspidatus** P.S.Ashton

(Latin, *cuspidatus* = pointed at the end; the leaf blade)

Gard. Bull. Sing. 23 (1967) 261, *op. cit.* (1968) 13, *op. cit.* (1982) 324; Anderson *op. cit.* (1980) 112; Newman *et al. op. cit.* 90. **Type:** *Ilias S 15821*, Borneo, Sarawak, Bintulu district, Labang FR (holotype K; isotypes KEP, L).

Medium-sized emergent tree, to 50 m tall, to 1.2 m diameter. **Bark** rust-brown. *Leaf buds densely persistently long buff-tomentose*; *twig*, *petiole*, *midrib above and venation below sparsely pubescent with persistent pale greyish brown bristle-like hairs*; *parts otherwise glabrous*. **Twigs** *c.* 1 mm diameter apically, very slender. Leaf buds oblong, *c.* 7 × 3 mm. **Leaves** chartaceous, *hardly corrugated*; *blade narrowly elliptic-ovate*, *6–11 × 2–4 cm*, base obtuse or occasionally broadly cuneate, *apex cuspidate*, *acumen to 2 cm long*, *slender*, *prominent*; *lateral veins 8–9 pairs*, slender but prominent below as also the midrib; *petiole 1.3–1.8 cm long*, very slender. **Inflorescences** to 5 cm long, terminal or axillary, singly branched. **Flowers** unknown. **Fruits:** *calyx tube subglobose*, *to 1.7 × 2 cm*, *with 5*, *c. 2.5 mm wide rigid flanges from base to apex*, *broadest towards apex*, *glabrescent*; 2 major calyx lobes to 8 × 2 cm, 3 minor ones ovate, to 0.7 × 0.5 cm, obtuse, becoming revolute.

Vernacular name. Sarawak—*keruing runcing* (preferred name).

Distribution. Endemic in Borneo and confined to Segan FR, Bintulu district, Sarawak (e.g., *S 15138*, *S 22061*, *S 22064*, and *S 27116*).

Ecology. Formerly scattered in mixed dipterocarp forest on sandy clay soils on low hills, at altitudes below 100 m. Endangered owing to land conversion and logging.

12. **Dipterocarpus elongatus** Korth.

(Latin, *elongatus* = attenuated; the leaf shape)

Kruidk. (1841) 62; Merrill *op. cit.* (1921) 398; Slooten *op. cit.* (1927) 272, *op. cit.* (1961) 473; Masamune *op. cit.* 486; Ashton *op. cit.* (1963) 237, *op. cit.* (1982) 312; PROSEA *op. cit.* 178; Coode *et al.* (eds.) *op. cit.* 68; Newman *et al. op. cit.* 91. **Type:** *Korthals s.n.* (= *RHL Sheet No. 91062130*), Borneo, Kalimantan, Barito, Sg. Punin (holotype L). **Synonyms:** *Dipterocarpus apterus* Foxw., *op. cit.* (1932) 77, Masamune *op. cit.* 485; *D. megacarpus* Madani, Sandakania 2 (1993) 1.

Large emergent tree, to 60 m tall, to 1.7 m diameter; crown open, spreading; buttresses stout, to 3 m tall. **Bark** greyish pink, overall smooth but thinly irregularly flaky. *Twig*, *leaf bud*, *stipule outside*, *petiole*, *inflorescence and calyx at first densely very long rufous-brown tufted tomentose*, *the tufts separating and caducous as parts expand*; *ovary apex persistently tomentose*. **Twigs** to 1.5 cm diameter apically, terete, reddish brown, becoming cracked and thinly flake. Leaf buds falcate, to 60 × 15 mm. **Stipules** *c.* 15 × 2.5 cm. **Leaves** coriaceous, prominently corrugated, drying dark rust-brown below; *blade elliptic*, *28–50 × 13–20 cm*, base obtuse, apex shortly abruptly acuminate; *lateral veins 25–38 pairs*, dense, prominent below; intercostal venation distantly scalariform; petiole 5–7 cm long, *c.* 5 mm diameter, stout. **Inflorescences** to 12 cm long, terminal or axillary, rarely branched. **Flowers** unknown. **Fruits:** *calyx tube ovoid becoming globose*, *to 5 × 5.5 cm*, *tomato-shaped with 5 distal swellings*, *constricted to c. 1.5 cm diameter at the neck*, *crowned by 5 subequal*, *obtuse*, *recurved lobes to 0.8 cm long*.

Vernacular names. Sarawak—*keruing latek* (preferred name), *kudan* (Murut), *ran* (Iban).

Distribution. E Sumatra, Peninsular Malaysia, Anambas Archipelago, and Borneo (except south and northwest parts). In Sabah known from Kinabatangan district (e.g., *SAN 133997* and *Wong et al. WKM 2342*) and in Sarawak from Bintulu district (e.g., *S 286*, *S 11736*, *S 15131*, and *S 27103*). Also occurring in Brunei (e.g., *BRUN 767*, *BRUN 2603*, *BRUN 5638*, *Coode 7081*, and *FMS 28683*) and W Kalimantan (e.g., *bb. 7855* and *Kostermans 9566*).

Ecology. Now rare, but formerly probably quite common and locally gregarious. In the floodplains where the rivers come out from the hills, especially on sandy alluvium; occasional on narrow riverine terraces further inland, at altitudes below 300 m. The fruit float in water. Critically endangered.

13. **Dipterocarpus eurynchus** Miq.

(Greek, *eu* = well, *rhynchos* = snout(ed); the sapling leaf acumen)

Fl. Ned. Ind., Suppl. (1862) 485; Slooten *op. cit.* (1927) 273, 302; Ashton *op. cit.* (1963) 238, *op. cit.* (1964) 30, *op. cit.* (1968) 14, *op. cit.* (1982) 324; Anderson *op. cit.* (1980) 112; PROSEA *op. cit.* 179; Coode *et al.* (eds.) *op. cit.* 68; Newman *et al. op. cit.* 92. **Type:** *Teijsmann HB 3255*, Sumatra, Bangka (holotype U). **Synonyms:** *Dipterocarpus eurynchoides* Scheff., Nat. Tijd. Ned. Ind. 31 (1870) 346; *D. appendiculatus* Scheff., *op. cit.* 347, Merrill *op. cit.* (1921) 397, Masamune *op. cit.* 485; *D. basilanicus* Foxw., *op. cit.* (1918) 179.

Medium-sized emergent tree, to 65 m tall, to 1 m diameter but usually smaller; bole frequently misshapen; crown distinctive when the old leaves turn coppery red before falling. **Bark** pale greyish brown, irregularly flaky and eventually shaggy. *Leaf buds densely persistently long buff-tomentose*; *twig*, *petiole and venation below sparsely but more or less* *persistently greyish pubescent*, *stipules and ovary apex persistently so*. **Twigs** *c.* 2 mm diameter apically, much-branched. Leaf buds conical, to 10 × 3 mm. **Stipules** *c.* 3 × 0. 8 cm. **Leaves** thinly coriaceous, drying dull yellow to pale orange-brown; *blade elliptic-obovate*, *4–6*(*–10*) × *2–3.5*(*–4. 5*) *cm*, base cuneate, *apex subacute to shortly acuminate*; *lateral veins 8–9 pairs*, ascending; *petiole 0.6–0.9 cm long*, *slender*. **Inflorescences** to 6 cm, simple or singly branched. **Flowers** unknown. **Fruits:** *calyx tube subglobose*, *to 1.7 × 2 cm*, *glabrescent*, *with 5*, *rigid*, *c. 2.5 mm wide flanges from base to apex*; 2 major calyx lobes to 8 × 2 cm, 3 minor ones ovate, to 0.7 × 0.5 cm, becoming revolute.

Vernacular name. Sarawak—*keruing baran* (preferred name).

Distribution. Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Sarawak known from Kapit, Limbang and Miri districts (e.g., *BRUN 3073*, *S 23818*, *S 23888*, and *S 60135*). Also occurring in Brunei (e.g., *BRUN 2600*, *BRUN 5235*, *BRUN 5254*, and *BRUN 5257*).

Ecology. In Sarawak and Brunei rare, scattered on high ridges of upper dipterocarp forest at 600–1000 m altitude. Occurring in Mulu NP but vulnerable elsewhere.

14. **Dipterocarpus fagineus** Vesque

(Latin, *fagineus* = like a beech (*Fagus*) tree; the leaves)

C. R. Ac. Sci. Paris 78 (March 1874) 625; King *op. cit.* 94; Merrill *op. cit.* (1921) 398; Ridley *op. cit.* (1922) 216; Slooten *op. cit.* (1927) 318; Symington, Bull. Misc. Inform Kew (1937) 318, *op. cit.* (1943) 177; Masamune *op. cit.* 486; Browne *op. cit.* 108; Ashton *op. cit.* (1968) 14, *op. cit.* (1978) 10; Anderson *op. cit.* (1980) 112; Newman *et al. op. cit.* 93. **Type:** *Beccari PB 3008*, Borneo, Sarawak, G. Matang (holotype P). **Synonyms:** *Dipterocarpus prismaticus* Dyer, J. Bot. 12 (April 1874) 104; *D. pseudofagineus* Foxw., *op. cit.* (1932) 82.

Medium-sized emergent tree, to 45 m tall, to 1 m diameter. **Bark** greyish brown, flaky. *Young twig*, *leaf bud*, *parts of flower exposed in bud*, *stipule outside*, *petiole*, *and inflorescence shortly evenly greyish brown pubescent*, *becoming glabrous on the inflorescence*. **Twigs** *c. 2 mm diameter apically*, *terete*. *Leaf buds falcate*, to 10 × 2.5 mm. **Stipules** to 2 × 0.3 cm. **Leaves** thinly coriaceous, *flat*, *drying pale rust-brown*, *sparsely pubescent especially along midrib and lateral veins or glabrescent below*; *blade narrowly elliptic to lanceolate*, *4–9*(*–12*) × *1.5–4*(*–5.5*) *cm*, base cuneate, apex acuminate, acumen slender to 0.8 cm long; midrib flat above, prominent below; *lateral veins 8–10 pairs*, slender but elevated below; *petiole 1.3–1.7 cm long*, *slender*, *to 2 mm diameter*, prominently geniculate. **Inflorescences** to 5 cm long, unbranched or singly branched. **Flowers:** buds *c.* 2 × 0.6 cm; stamens *c.* 15. **Fruits:** *calyx tube subglobose to ellipsoid*, *to 1 × 0.8 cm*, tapering into a *c.* 6 mm long pedicel, *with 5 slender acute ribs from base or distally only*; 2 major calyx lobes to 8 × 1.5 cm; 3 shorter ones deltoid, to 0.6 × 0.5 cm.

Vernacular name. Sarawak—*keruing pipit* (preferred name).

Distribution. Sumatra (Riau and Lingga Archipelagoes), Peninsular Malaysia, and Borneo. Rare in Sarawak, known only from Kapit, Kuching (G. Matang) and Simunjan (G. Gaharu) districts (e.g., *S 15539*, *S 43809* and *S 57613*).

Ecology. Rare in mixed dipterocarp forest on hills. Conservation status unknown.

Notes. A clearly defined species outside Borneo but the Sarawak specimens, including the type, are hardly distinguishable from *D. acutangulus*, and bear close resemblance also to *D. borneensis*.

15. **Dipterocarpus fusiformis** P.S.Ashton

(Latin, *fusiformis* = spindle-shaped; the fruit calyx tube)

Gard. Bull. Sing. 31 (1978) 12, *op. cit.* (1982) 319; Kessler & Sidiyasa *op. cit.* 93; Newman *et al. op. cit.* 93. **Type:** *Singh SAN 39170*, Borneo, Sabah, Sandakan district, Mile 81, Labuk Road (holotype L; isotype SAN).

Large emergent tree. **Bark** greyish. *Young parts densely buff-velutinous*; *persistent on leaf buds*, *stipule outside and ovary apex*; *sparsely so on twig*, *leaf below and petiole*; *caducous elsewhere*. **Twigs** *slender*, *c.* 2 mm diameter apically. *Leaf buds linear-falcate*, *to 15 × 3 mm*. **Stipules** lanceolate, *c.* 3 × 0.6 cm. **Leaves** coriaceous, *hardly corrugated*, drying yellowish brown; *blade elliptic or narrowly ovate*, *7–17 × 3–7 cm*, base cuneate or obtuse, apex prominently acuminate, acumen slender to 12 cm long; *lateral veins 13–17 pairs*, slender but prominent below; *petiole 2–2.6 cm long*, *slender*. **Inflorescences** and **flowers** unknown. **Fruits:** *calyx tube ellipsoid*, *to 2.8 × 1.8 cm*, *glabrous*, *with 5*, *to 6 mm wide incrassate flanges or narrow ridges continuous from base to apex but generally broadest distally*; 2 major calyx lobes to 10 × 2.6 cm, 3 minor ones suborbicular, to 0.5 × 0.5 cm, subrevolute.

Distribution. Endemic in Borneo. In Sabah recorded from Kinabatangan, Lahad Datu, Ranau, Sandakan, Semporna, and Tawau districts (e.g., *SAN 15379*, *SAN 16952*, *SAN 17178*, *SAN 63787*, *SAN 97110*, and *SAN 100176*). Also occurring in Kalimantan (e.g., *Sidiyasa S 462*).

Ecology. In mixed dipterocarp forest on well-structured and well-drained clay soils, on basic volcanic and shale substrates, at altitudes to 600 m. Endangered by land conversion.

16. **Dipterocarpus geniculatus** Vesque

(Latin, *geniculatus* = with bent knee; the petiole)

C. R. Ac. Sci. Paris 78 (March 1874) 626; Merrill *op. cit.* (1921) 398; Slooten *op. cit.* (1927) 317, *op. cit.* (1941) 99; Masamune *op. cit.* 486; Meijer & Wood *op. cit.* 248; Burgess *op. cit.* 900; Browne *op. cit.* 109; Ashton *op. cit.* (1968) 14, *op. cit.* (1982) 320; Anderson *op. cit.* (1980) 112; PROSEA *op. cit.* 179; Newman *et al. op. cit.* 94. **Type:** *Beccari PB 3034*, Borneo, Sarawak (holotype P). **Synonym:** *Dipterocarpus angulatus* Dyer, J. Bot. 12 (April 1874) 104.

Emergent tree, to 60 m tall, to 2 m diameter; crown wide, large-leaved. **Bark** chocolate-brown, becoming irregularly, eventually shaggily flaked. *Young twig*, *leaf buds*, *stipule outside*, *ovary*, *fruit calyx tube*, *and inflorescence persistently densely evenly pale cream-pubescent with short hairs*; *fruit calyx lobes*, *petiole and leaf venation below sparsely more or less caducously so*. **Twigs** to 13 mm diameter apically, with rows of elongate lenticels and sinuate stipule scars. Leaf buds broadly ovoid, *c.* 25 × 20 mm. **Stipules** lanceolate, *c.* 6 × 2 cm. **Leaves** *coriaceous*, *weakly corrugated*, *shiny above*, *sparsely pubescent or glabrous below*, drying pale chocolate-brown; blade elliptic to obovate, base obtuse, apex obtuse to shortly acuminate; *lateral veins 10–12 pairs*, prominent below, well-spaced; *petiole 3–10 cm long*, stout, *glabrous.* **Inflorescences** to 24 cm long, axillary, singly or occasionally doubly branched. **Flowers:** buds to 3.5 × 1cm; stamens *c.* 30, anthers short, narrowly oblong. **Fruits:** *calyx tube glabrescent*, *obovoid-globose*, *c. 1.5 × 1.5 cm*, *tapering to pedicel*, *with 5 stout continuous ridges to 3 mm wide towards the undulate distal ends*; 2 major calyx lobes 12–15 × 2.5–4 cm, 3 minor calyx lobes cordate, *c.* 1 × 1.5 cm, the sides recurved.

Vernacular names. Sabah—*keruing tangkai panjang* (preferred name). Sarawak—*keruing kerubung* (preferred name).

Distribution. Endemic in Borneo.

Notes. In Sabah and Sarawak, two subspecies, *viz.* subsp. *geniculatus* and subsp. *grandis*, are recognised.

Key to subspecies

Twigs to 7 mm diameter apically. Leaf blade 7–12 × 5–7 cm; petiole 3–5 cm long. Two major fruit calyx lobes to 12 × 2.5 cm………………………………..……………………

subsp. **geniculatus**

Known in Sarawak from Belaga, Bintulu, Kuching, Lundu, and Miri districts (e.g., *S 11054*, *S 15144*, *S 16475*, *S 32411*, *S 68679*, and *SFN 36109*) and in W Kalimantan from the Lower Kapuas drainage (e.g., *bb. 8322*). In mixed dipterocarp forest on low hills and valleys on leached sandy and sandy and silty clay soils, at altitudes to 400 m; locally common. Vulnerable though locally frequent in Bako NP.

Twigs to 13 mm diameter apically. Leaf blade 20–35 × 12–16 cm; petiole to 10 cm long. Two major fruit calyx lobes to 15 × 4 cm.………………………………………………..…..

subsp. **grandis** P.S.Ashton

(Latin, *grandis* = large; the twig and associated organs)

Gard. Bull. Sing. 20 (1963) 240, *op. cit.* (1964) 11; Meijer & Wood *op. cit.* 248; Coode *et al.* (eds.) *op. cit.* 68; Newman *et al. op. cit.* 95. Type: *Dzulkiple S 1870*, Borneo, Brunei, Ladan Hills FR (holotype KEP).

Known from Sipitang district in Sabah (e.g., *SAN 15132* and *SAN A 4051*) and from Limbang and Miri districts in Sarawak (e.g., *S 1829* and *S 46505*). Also occurring in Brunei (e.g., *BRUN 3064*, *FMS 30586* and *FMS 35666*). As subsp. *geniculatus*, and on ultrabasic rocks in E Sabah. Vulnerable though common in Lambir NP.

17. **Dipterocarpus glabrigemmatus** P.S.Ashton

(Latin, *glabrus* = hairless, *gemmatus* = budded; the glabrous leaf buds)

Gard. Bull. Sing. 31 (1978) 11, *op. cit.* (1968) 19 ('32. *Dipterocarpus* sp.'), *op. cit.* (1982) 318. **Type:** *Jugah S 23849*, Borneo, Sarawak, Kapit district, Bt. Raya (holotype K; isotypes KEP, SAR).

Medium-sized to large tree. *Midrib and veins sparsely pubescent*, *ovary densely so*; *parts otherwise glabrous*. **Twigs** *c.* 3 × 2 mm apically, somewhat compressed and ribbed, shiny. *Leaf buds* ovoid, *c.* 6 × 4 mm, acute, *glabrous*, *drying black*, *occasionally sparsely tomentose*. **Leaves** *glabrous except on the midrib and veins*, *drying warm rust-brown*, *more* *or less corrugated*; blade broadly ovate, 6–9 × 4.5–6 cm, base obtuse, margin prominently sinuate distally, apex with an acumen to 0.5 cm long; midrib prominent below; *lateral veins 10–11 pairs*, prominent below; *petiole 1.5–2.5 cm long*, slender, drying rugose. **Inflorescences** to 10 cm long, unbranched. **Flowers:** buds to 2.5 × 1.2 cm; *calyx tube broadly flanged*; *stamens c. 15*, anthers linear. **Fruits** unknown.

Distribution. Endemic in Borneo. Known in C Sarawak from Kapit district (e.g., *S 22339*, *S 23163*, *S 24224*, *S 24250*, and *Smythies s.n.*) and in C and E Kalimantan.

Ecology. In mixed dipterocarp forest on shale ridges, at altitudes to 600 m. Rare and endangered.

18. **Dipterocarpus globosus** Vesque

(Latin, *globosus* = spherical; the fruit calyx tube)

C. R. Ac. Sci. Paris 78 (March 1874) 627; Merrill *op. cit.* (1921) 398; Slooten *op. cit.* (1927) 304, *op. cit.* (1941) 98; Masamune *op. cit.* 486; Browne *op. cit.* 109; Ashton *op. cit.* (1964) 33, *op. cit.* (1968) 15, *op. cit.* (1982) 311; Burgess *op. cit.* 100; Anderson *op. cit.* (1980) 112; PROSEA *op. cit.* 180; Coode *et al.* (eds.) *op. cit.* 68; Newman *et al. op. cit.* 97. **Type:** *Beccari PB 2914*, Borneo, Sarawak, Matang (holotype P). **Synonyms:** *Dipterocarpus beccarianus* Vesque *op. cit.* 627; *D. beccarii* Dyer, J. Bot. 12 (April 1874) 103.

Large emergent tree, to 65 m tall, to 2 m diameter; buttresses to 3.5 m tall and wide, stout, concave, many. **Bark** pale greyish brown, cleanly vertically cracked and thinly flaking. *Young parts at first persistently shortly chestnut pubescent*; *leaf buds and stipule outside persistently densely long chestnut tomentose*. **Twigs** *5–8 mm diameter apically*, *stout*. Leaf buds ovoid, *c.* 1 × 0.8 cm, acute. **Stipules** narrowly lanceolate, *c.* 7 × 0.7 cm, acute. **Leaves** thickly coriaceous, corrugated, *glabrous or glabrescent below*; blade broadly ovate, 10–14 × 7–9 cm, base broadly cuneate, margin sinuate, apex broadly acuminate, acumen to 0.4 cm long; midrib and veins below fugaceous puberulent; *lateral veins 12–14 pairs*, well-spaced, prominent below; *petiole 2–2.5 cm long*, *stout*, *at least 2 mm diameter*. **Inflorescences** to 8 cm long, axillary, singly branched. **Flowers** unknown. **Fruits:** *calyx tube subglobose or globose*, to 3.5 cm long and broad, *more or less 5-ribbed from the impressed base to the constricted apex*, *most prominent and slightly tuberculate distally*; 2 major calyx lobes to 15 × 3.5 cm, 3 minor ones deltoid, 0.4–0.5 cm long and broad, becoming recurved and revolute.

Vernacular name. Sabah and Sarawak—*keruing buah bulat* (preferred name).

Distribution. Endemic in Borneo. Known in Sarawak from Bintulu, Kuching, Lundu, Miri, Serian and Simunjan districts (e.g., *S 10058*, *S 21421*, *S 22052*, *S 27176*, and *S 27968*). Also occurring in Brunei (e.g., *BRUN 5540*, *FMS 30488*, *FMS 35531*, and *FMS 48175*).

Ecology. In mixed dipterocarp forest on deep yellow sandy soils, on coastal hills at altitudes below 400 m. One of the most abundant large dipterocarps on sandy coastal hills between Mukah (Sarawak) and Andulau forest (Brunei), including the Lambir Hills NP. Endangered outside parks system.

19. **Dipterocarpus gracilis** Blume

(Latin, *gracilis* = slender; the twig and petiole)

Bijdr. Fl. Ned. Ind. (1825) 224; Fl. Java 2 (1829) 20; Slooten *op. cit.* (1927) 276, *op. cit.* (1940) 434; Masamune *op. cit.* 486; Symington *op. cit.* (1943) 177; Ashton *op. cit.* (1963) 235, *op. cit.* (1964) 35, *op. cit.* (1968) 15, *op. cit.* (1982) 301; Backer & Bakhuizen *f. op. cit.* 329; Meijer & Wood *op. cit.* 250; Burgess *op. cit.* 100; Anderson *op. cit.* (1980) 112; PROSEA *op. cit.* 180; Kessler & Sidiyasa *op. cit.* 94; Coode *et al.* (eds.) *op. cit.* 68; Newman *et al. op. cit.* 98. **Type:** *Blume 1256* (= *RHL Sheet Nos. 902146–113*, *114 & 118*), Java, G. Parang (holotype L; isotype NY). **Synonyms:** *Dipterocarpus marginatus* Korth., *op. cit.* 64; *D. fulvus* Blume, Mus. Bot. Lugd.-Bat. 2 (1852) 37; *Anisoptera palembanica* Miq., *op. cit.* (1862) 191, 485; *D. bancanus* Burck, Ann. Jard. Bot. Buitenz. 6 (1887) 196; *D. skinneri* King *op. cit.* 91; *D. vanderhoevenii* Koord. & Valeton, Bull. Inst. Bot. Buitenz. 2 (1899) 3; *Shorea mollis* Boerl., Cat. Hort. Bog. 2 (1901) 110. (For other synonyms, *cf.* Ashton *op. cit.* (1982) 301).

Large emergent tree, to 50 m tall, to 1.5 m diameter; *crown rufous from below*. **Bark** reddish brown, becoming thinly patchily irregularly flaky. *Living exposed parts and ovary more or less densely rufous scabrid-tomentose*, *persistent except on leaf upper surface and calyx*. **Twigs** *c.* 3 mm diameter apically. Leaf buds narrowly conical, *c.* 10 × 3 mm, obtuse. **Stipules** narrowly lanceolate, *c.* 5 cm long. **Leaves** thinly coriaceous, *not concave*, drying rufous brown; *blade elliptic to ovate*, *8–15 × 4–10 cm*, base obtuse, apex shortly acuminate; *lateral veins 12–20 pairs*, *dense*; *petiole 2–2.5 cm long*, *slender*. **Inflorescences** to 9 cm long, terminal or axillary, singly branched. **Flower:** buds *c.* 2.5 × 0.8 cm; *stamens c. 30*, anthers linear. **Fruits:** calyx glabrescent; *tube globose*, *c. 2 cm diameter*, *smooth*; *2 major calyx lobes to 14 × 2.5 cm*, *3 minor ones ovate*, *to 2.2 × 1 cm*, *becoming recurved and revolute*.

Vernacular name. Sabah and Sarawak—*keruing kesat* (preferred name).

Distribution. Andamans and Chittagong to the Philippines and W Java; throughout Borneo but not in the western parts. In Sabah recorded from Beaufort, Keningau, Kinabatangan, Kudat, Lahad Datu, Sandakan, Semporna, Sipitang, and Tawau districts (e.g., *SAN 15094*, *SAN 15510*, *SAN 16347*, *SAN 16406*, and *SAN 19141*) and in Sarawak from Belaga, Kapit, Lawas, Limbang, and Marudi districts (e.g., *S 1694*, *S 13986*, *S 16534*, *S 22260*, and *S 22735*). Also occurring in Brunei (e.g., *BRUN 3226*, *FMS 35591* and *SAN 17116*) and SE Kalimantan (e.g., *bb. 19800*).

Ecology. In mixed and upper dipterocarp forest on humus-rich clay soils, at altitudes to 800 m. Usually rare, as scattered trees, but occasionally locally common, especially on volcanic soils in E Sabah lowlands. Probably endangered.

20. **Dipterocarpus grandiflorus** (Blanco) Blanco Plate 2C.

(Latin, *grandis* = large, *florus* = flower; with large flowers)

Fl. Filip. ed. 2 (1845) 314, Fl. Filip. ed. 3, 2 (1878) 218; King *op. cit.* 95; Merrill, Sp. Blancoan. (1918) 268, *op. cit.* (1921) 398, *op. cit.* (1929) 201; Slooten *op. cit.* (1927) 333; Masamune *op. cit.* 486; Symington *op. cit.* (1943) 178; Meijer & Wood *op. cit.* 252; Burgess *op. cit.* 100; Ashton *op. cit.* (1982) 317; PROSEA *op. cit.* (1993) 180; Newman *et al. op. cit.* (1998) 99. **Basionym:** *Mocanera grandiflora* Blanco, Fl. Filip. ed. 1 (1837) 451. **Neotype** (designated here)**:** *Merrill Sp. Blancoan. 119* (= *US 903794*), the Philippines, Bataan Province, Luzon, Mt. Lamao (K; US). **Synonyms:** *Dipterocarpus blancoi* Blume *op. cit.* (1852) 35; *Vatica trigyna* Griff., Notul. 4 (1854) 514; *D.*

motleyanus Hook.*f.*, Trans. Linn. Soc. 23 (1860) 159; *D. griffithii* Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 213; *D. pterygocalyx* Scheff., *op. cit.* 347.

Medium-sized, occasionally large, emergent tree, to 45 m tall, to 1.5 m diameter; crown dense, dark, irregular. **Bark** pale greyish to yellowish brown, appearing smooth but becoming irregularly flaky. *Leaf bud*, *outside of stipules*, *parts exposed in bud*, *ovary apex*, *and sometimes twig densely evenly pale buff-pubescent*; *parts otherwise glabrous*. **Twigs** *terete*, *to 12 mm diameter apically*, *stout*; internodes short, the leaves clustered round the ends. Leaf buds ovoid, acute, to 20 × 10 mm. **Stipules** oblong-lanceolate, to 18 × 5 cm. **Leaves** thickly coriaceous, hardly corrugated, *glabrous*, drying pinkish brown; blade broadly ovate, 10–18 × 5–12 cm, base obtuse to subcordate, apex with acumen to 1 cm long; *lateral veins 15–17 pairs*, prominent below, spreading; *petiole to 9 cm long*, *at least 2 mm diameter*, *stout*. **Inflorescences** to 18 cm long, unbranched, slender, borne in dense groups behind the leaves. **Flowers:** buds to 3.5 × 1.3 cm; *stamens c. 30*, anthers linear-lanceolate, tapering. **Fruits:** pedicel stout; *calyx tube glabrous*, *ellipsoid*, *to 7 × 3.5 cm*, *with 5*, *to 15 mm wide prominent coriaceous pruinose flanges from base to apex*; 2 major calyx lobes to 22 × 3 cm, 3 minor ones elliptic, to 2 × 1.5 cm, subrevolute.

Vernacular name. Sabah—*keruing belimbing* (preferred name).

Distribution. Andamans, Myanmar, Thailand, Vietnam, Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Borneo known only in Sabah and recorded from Kota Kinabalu, Kudat, Lahad Datu, Papar, Sandakan, and Semporna districts (e.g., *SAN 18854*, *SAN 19749*, *SAN 27192*, *SAN A 287*, and *SAN A 1247*).

Ecology. Locally common on dry ridges and low hills, at altitudes below 400 m, within 150 km of the coast; spreading inland, especially on ridges, in drier climates. Vulnerable.

21. **Dipterocarpus hasseltii** Blume

(J.C. van Hasselt, 1797–1823, a Dutch botanist)

Fl. Java 2 (1829) 22; Slooten *op. cit.* (1927) 280, *op. cit.* (1940) 436; Foxworthy *op. cit.* (1932) 67; Masamune *op. cit.* 486; Symington *op. cit.* (1943) 180; Backer & Bakhuizen *f. op. cit.* 329; Meijer & Wood *op. cit.* 255; Ashton *op. cit.* (1978) 8, *op. cit.* (1982) 306; PROSEA *op. cit.* 181; Kessler & Sidiyasa *op. cit.* 94; Newman *et al. op. cit.* 101. **Type:** *van Hasselt s.n.* (= *RHL Sheet Nos. 902146210–211*), Java, Banten, Menes (holotype L). **Synonyms:** *Dipterocarpus quinquegonus* Blume *op. cit.* (1852) 36; *D. balsamiferus* Blume *op. cit.* (1852) 37, Merrill *op. cit.* (1921) 397, Masamune *op. cit.* 485; *D. lampongus* Scheff., *op. cit.* 146; *D. subalpinus* Foxw. *in* Elmer, Leafl. Philip. Bot. 6 (1913) 1950. (For other synonyms, *cf.* Ashton *op. cit.* (1982) 306).

Stately emergent tree, to 55 m tall, to 2 m diameter, with dense hemispherical crown and tall buttresses. **Bark** overall smooth, thinly flaky, greyish brown. *Parts exposed in flower bud and ovary apex buff-pubescent*; *veins below sparsely so*, *usually caducous*; *parts otherwise glabrous*. **Twigs** *c.* 4 × 2 mm apically, somewhat compressed, drying black. *Leaf buds falcate*, *to 20 × 5 mm*, *glabrous*, *drying black*. **Stipules** lorate-lanceolate, *c.* 12 × 1 cm, *glabrous*. **Leaves** *thinly coriaceous*, *hardly corrugated*, *glabrous*, drying dull greyish brown; *blade narrowly elliptic*, *9–16 × 5–10 cm*, base cuneate, margin often prominently wavy, apex with acumen to 1 cm long; *lateral veins 11–14 pairs*, slender but prominent below, ascending; *intercostal venation densely regularly scalariform*; *petiole 2.5–4 cm long*, slender. **Inflorescences** to 10 cm long, axillary, hardly branched. **Flowers:** bud *c.* 3 × 1 cm; *stamens c. 30*, anthers linear, somewhat tapering. **Fruits:** pedicels to 3 mm long; *calyx tube* globose, to 3 cm diameter, *smooth*; *2 major calyx lobes to 22 × 3 cm*, *3 minor ones suborbicular*, *to 1.5 × 0.3 cm*, *somewhat revolute.*

Vernacular name. Sabah—*keruing kerukup kecil* (preferred name).

Distribution. Peninsular Thailand, Sumatra, Peninsular Malaysia, W Java, Nusa Tenggara (Bali Is.), Borneo, and the Philippines. In Borneo recorded from Kinabatangan, Pensiangan, Sandakan, and Tawau districts in Sabah (e.g., *FMS 55342*, *KEP 70522*, *SAN 15517*, *SAN 18464*, and *SAN 23596*) and E Kalimantan (e.g., *Kostermans 4886* and *Kostermans 4956*).

Ecology. In mixed dipterocarp forest on lower slopes and moist (but not swampy) valleys, especially on fertile soils over basic volcanic rock, at altitude to 500 m. Critically endangered owing to forest conversion.

22. **Dipterocarpus humeratus** Slooten Fig. 7.

(Latin, *humerus* = shoulder; the articulated petiole)

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 308; Ashton *op. cit.* (1963) 237, *op. cit.* (1964) 36, *op. cit.* (1968) 15, *op. cit.* (1982) 311; Meijer & Wood *op. cit.* 257; Burgess *op. cit.* 100; Anderson *op. cit.* (1980) 112; PROSEA *op. cit.* 181; Coode *et al.* (eds.) *op. cit.* 68; Newman *et al. op. cit.* 102. **Lectotype** (designated here)**:** *bb. E 1150*, Sumatra, Palembang, Lematang Hilir, near G. Megang (hololectotype BO; isolectotype K).

Emergent tree, to 50 m tall, to 1 m diameter; buttresses to 2 m tall. **Bark** pinkish brown, irregularly flaking. *Young twig*, *petiole*, *midrib and vein below cream puberulent*; *leaf bud and stipule outside shaggily fulvous hispid*; *ovary and raceme golden-brown pubescent.* **Twigs** *c.* 1 cm diameter apically, stout, becoming thinly flaky. Leaf buds narrowly conical, to 50 × 15 mm, obtuse. **Stipules** narrowly lanceolate, *c.* 10 × 2 cm. **Leaves** thickly coriaceous, *corrugated*, drying chocolate-brown, *sparsely pubescent below*; *blade broadly ovate*, *20–38 × 12–23 cm*, base obtuse, apex obtuse to shortly acuminate; *lateral veins c. 20 pairs*, prominent, well-spaced; *petiole 4–6 cm long*, stout, prominently geniculate. **Inflorescences** to 21 cm long, terminal or axillary, hardly or not branched. **Flowers:** buds *c.* 5 × 2 cm; stamens *c.* 40, anthers linear, tapering. **Fruits** subsessile; *calyx tube globose*, to 4 × 3.5 cm, *with 5 obtuse tubercles distally*; *2 major calyx lobes to 18 × 5 cm*, *3 minor ones broadly ovate*, *to 1.5 × 1.5 cm*, subcordate, with obtuse apex, revolute back to back.

Vernacular names. Sabah—*keruing kerukup* (preferred name). Sarawak—*keruing latek bukit* (preferred name).

Distribution. Sumatra and Borneo. In Sabah known from Kinabatangan, Ranau, Sandakan, and Tawau districts (e.g., *FMS 48854*, *SAN 15393*, *SAN 18568*, and *SAN A 4142*) and in Sarawak from Lawas, Limbang and Tatau districts (e.g., *BRUN 805*, *S 24955* and *S 30229*). Also occurring in Brunei (e.g., *BRUN 329*, *BRUN 330* and *BRUN 2618*) and SE Kalimantan (e.g., *bb. 26595*).

Ecology. In mixed dipterocarp forest on well-drained clay soils; on low hills in eastern Sabah, and high shale ridges at 200–700 m altitude in Sarawak and Brunei. Occurring in Mulu NP; probably vulnerable elsewhere.

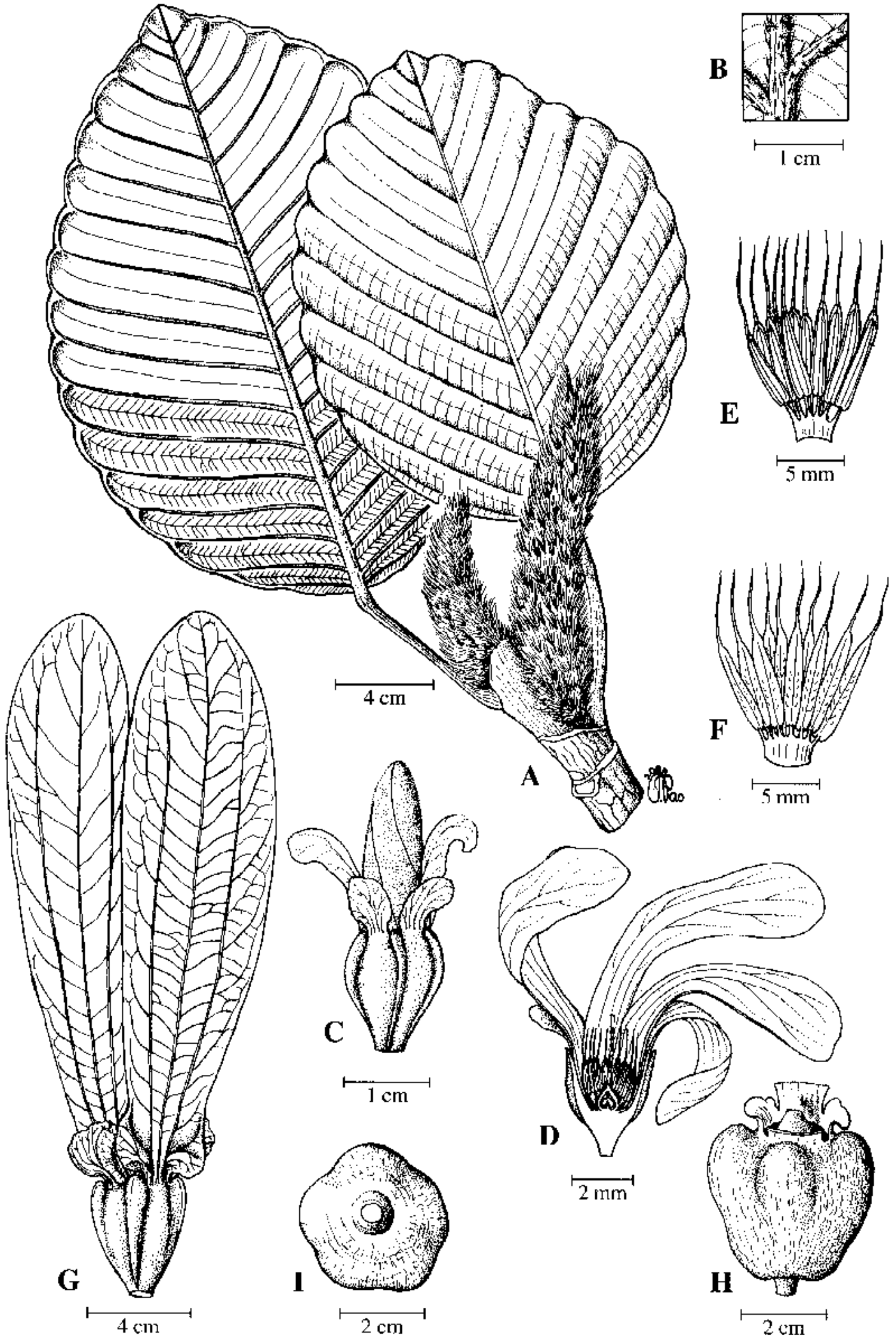

Fig. 7. *Dipterocarpus humeratus*. A, leafy twig; B, detail of indumentum on lower leaf surface; C, flower bud; D, longitudinal section of open flower; E, adaxial view of stamens; F, abaxial view of stamens; G, side view of almost mature fruit; H, side view of mature fruit with the larger calyx lobes removed; I, basal view of mature fruit calyx tube. (A–B from *FMS 48864*, C from *SAN 15393*, D–F from *FMS 38752*, G from *SAN 17327*, H–I from *SAN 31397*.)

23. **Dipterocarpus kerrii** King

(A.F.G. Kerr, 1877–1942, introduced western medical practise to Siam, prodigious amateur botanist)

J. As. Soc. Beng. 62, 2 (1893) 93; Ridley *op. cit.* (1922) 215; Slooten *op. cit.* (1927) 295; Foxworthy *op. cit.* (1932) 69; Symington *op. cit.* (1943) 181; Meijer & Wood *op. cit.* 259; Burgess *op. cit.* 101; Ashton *op. cit.* (1982) 305; PROSEA *op. cit.* 182; Newman *et al. op. cit.* 103. **Lectotype** (designated here)**:** *Kerr 7438/7349*, S Thailand, Pattani (hololectotype K). **Synonyms:** *Dipterocarpus obconicus* Foxw. *in* Elmer *op. cit.* (1913) 1951; *D. perturbinatus* Foxw., *op. cit.* (1918) 177; *D. cuneatus* Foxw., *op. cit.* (1918) 178.

Large emergent tree, to 50 m tall, to 1.2 m diameter; crown dense, compact, dark. **Bark** pale greyish to yellowish brown, thinly irregularly flaky. *Parts of petals exposed in bud*, *inside of bud scales and stipules*, *and ovary densely silky cream pubescent*; *parts otherwise glabrous.* **Twigs** *c.* 3 mm diameter apically, drying black. *Leaf buds lanceolate-falcate*, *to 12 × 3 mm*, *glabrous*, *drying black.* **Stipules** linear-lanceolate, *c.* 8 × 0.5 cm. **Leaves** coriaceous, drying dark chocolate-brown, *glabrous below*; *blade broadly elliptic*, *8–13 × 3.3–7 cm*, *base cuneate*, apex with acumen less than 0.5 cm long; *lateral veins* (*7–*)*9–11 pairs*, slender but prominent below, ascending; intercostal venation densely scalariform, very slender, hardly raised; *petiole 2–2.8 cm long*, slender. **Inflorescences** to 8 cm long, unbranched or singly branched. **Flowers:** buds *c.* 2.5 × 1 cm; *stamens c. 30*, anthers subauriculate, narrowly deltoid. **Fruits:** pedicels to 3 mm long, stout; *calyx tube* globose to turbinate, to 3.5 cm diameter, *smooth*; *2 major calyx lobes to 14 × 3 cm*, *3 minor ones suborbicular*, *to 1 × 1 cm*, *subrevolute.*

Vernacular name. Sabah—*keruing gondol* (preferred name).

Distribution. Andamans, Myanmar, Peninsular Thailand, Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Borneo only known in the eastern parts of Sabah and recorded from Kinabatangan, Labuk Sugut and Sandakan districts (e.g., *SAN 16247*, *SAN 16329*, *SAN 16350*, *SAN 96959*, and *SAN 97202*).

Ecology. In mixed dipterocarp forest on well-drained clay soils on low hills, at altitudes to 400 m, near the coast in aseasonal climates. Locally frequent in scattered localities down the east coast of Sabah. Highly vulnerable, possibly endangered.

24. **Dipterocarpus kunstleri** King

(H.H. Kunstler, 1837–1887, King's plant collector in Perak)

J. As. Soc. Beng. 62, 2 (1893) 96; Ridley *op. cit.* (1922) 217; Slooten *op. cit.* (1927) 327; Symington *op. cit.* (1943) 182; Ashton *op. cit.* (1978) 10, *op. cit.* (1982) 309; PROSEA *op. cit.* 182; Coode *et al.* (eds.) *op. cit.* 69; Newman *et al. op. cit.* 104. **Type:** *King's collector 3798*, Peninsular Malaysia, Perak, Larut (holotype K). **Synonyms:** *Dipterocarpus speciosus* Brandis, J. Linn. Soc. Bot. 31 (1895) 38; *D. exalatus* Slooten *ex* Wood, Gard. Bull. Sing. 17 (1960) 486, Slooten *op. cit.* (1961) 462, Ashton *op. cit.* (1964) 31, *op. cit.* (1968) 14, Meijer & Wood *op. cit.* 246, Burgess *op. cit.* 100, Anderson *op. cit.* (1980) 112.

Main canopy tree, to 40 m tall, to 1 m diameter; bole relatively short. **Bark** pale orange-brown, patchily thinly flaky. *Leaf venation puberulent or glabrous below*; *leaf buds and stipule outside persistently densely pale grey adpressed puberulent*; *parts otherwise glabrous*. **Twigs** *slender*, *to 5 mm diameter apically*, often slightly ribbed or compressed, with prominent stipule scars. Leaf buds narrowly falcate, to 15 × 3.5 mm. **Stipules** linear, to 7 × 0.8 cm. **Leaves** chartaceous, *glabrous*, drying greyish brown below; blade elliptic to broadly lanceolate, 13–22 × 7–10 cm, base cuneate, apex shortly acuminate (mature trees); *lateral veins 16–18 pairs*, slender but prominent below, ascending; *petiole 2–3 cm long*, *slender*, *to 2 mm diameter*. **Inflorescences** to 22 cm long, singly branched, terminal or axillary. **Flowers:** buds *c.* 3.5 × 1.5 cm; stamens *c.* 30, anthers narrow, tapering. **Fruits:** *calyx tube* ellipsoid, to 5 × 2.5 cm, tapering gradually to the base and to the constricted neck, *5-ribbed or almost winged*, *the ribs c. 7 mm wide and 4 mm thick apically*, *either confined to the distal half or tapering to the base*, *terminating apically as obtuse tubercles*; 2 major calyx lobes to 11 × 1.5 cm, of variable length and sometimes subequal with minor lobes, 3 minor ones to 0.6 × 0.5 cm, recurved, thickened.

Vernacular names. Sabah—*keruing rapak* (preferred name). Sarawak—*keruing kuntum putih* (preferred name).

Distribution. Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Borneo known in Sabah from Beaufort, Kinabatangan, Lahad Datu, Papar, Ranau, Sandakan, Sipitang, and Tawau districts (e.g., *FMS 38783*, *SAN 16037*, *SAN 17177*, *SAN 21273*, *SAN 38149*, and *SAN 97486*) and in Sarawak from Kapit, Lundu, Limbang, Marudi and Miri districts (e.g., *S 1813*, *S 7959*, *S 22330*, *S 23330*, and *S 23351*). Also occurring in Brunei (e.g., *BRUN 138*, *BRUN 298*, *BRUN 903*, and *BRUN 3075*) and E and SE Kalimantan (e.g., *bb. 18424*, *bb. 20644*, *bb. 25609*, *Kostermans 7254*, and *Kostermans 9745*).

Ecology. Locally frequent in mixed dipterocarp forest on leached silty clay soils, mainly in moist valleys and lower hillsides, at altitudes to 400 m. Most abundant in E Sabah, in scattered localities elsewhere. Highly vulnerable though occurring in Bako and Mulu NPs.

25. **Dipterocarpus lamellatus** Hook.*f.*

(Latin, *lamellatus* = thinly plated; the fruit calyx tube flanges)

Trans. Linn. Soc. 23 (1860) 159; Merrill *op. cit.* (1921) 399; Slooten *op. cit.* (1927) 347; Masamune *op. cit.* 487; Meijer & Wood *op. cit.* 261; Burgess *op. cit.* 101; Ashton *op. cit.* (1982) 312; Coode *et al.* (eds.) *op. cit.* 69; Newman *et al. op. cit.* 105. **Type:** *Motley 159*, Borneo, Labuan (holotype K).

Tall emergent tree, to 55 m, to 1.2 m diameter; crown golden from below. *Exposed living parts and ovary persistently yellowish brown scabrid-hirsute*, *leaf blade and fruit calyx sparsely so*; *parts otherwise densely scabrid-hirsute*. **Twigs** *terete*, *c.* 4 mm diameter apically. Leaf buds ovoid, to 9 × 7 mm, acute. **Stipules** lanceolate, *c.* 3 × 0.8 cm. **Leaves** chartaceous, *boat-shaped and concave*; blade elliptic, 13–16 × 6–9 cm, base narrowly obtuse, apex with abrupt, slender acumen to 0.8 cm long; *lateral veins 15–17 pairs*, slender but prominent below, shallowly sunken above; intercostal venation distinctly elevated below, evident above; *petiole 3–4 cm long*, *slender*. **Inflorescences** to 8 cm long, axillary, hardly branched. **Flowers** unknown. **Fruits:** pedicels to 4 mm long, slender; *calyx tube subglobose*, *to 1.8 cm long including the 5 densely convoluted flanges*; 2 major calyx lobes to 14 × 2.5 cm, 3 minor ones ovate, to 1.4 × 0.7 cm, revolute.

Vernacular name. Sabah—*keruing jarang* (preferred name).

Distribution. Endemic in Borneo; known only from Beaufort Hill FR and Labuan, in SW Sabah (e.g., *SAN 16251* and the type) and Ladan Hills, Tutong district in Brunei (e.g., *Wong 1652*).

Ecology. With *Shorea dispar* one of the rarest and most endangered of all dipterocarps. Found in mixed dipterocarp forest on yellow sandy soil on hills, at altitudes below 200 m, within 50 km of the coast. Probably extinct in Sabah due to the loss of its habitat.

26. **Dipterocarpus lowii** Hook.*f.* Fig. 8.

(Sir Hugh Low, 1824–1905; Officer of the British East India Company, plant collector)

Trans. Linn. Soc. 23 (1860) 160; Merrill *op. cit.* (1921) 399, *op. cit.* (1929) 201; Slooten *op. cit.* (1927) 433; Masamune *op. cit.* 487; Symington *op. cit.* (1943) 183; Browne *op. cit.*110; Ashton *op. cit.* (1964) 37, *op. cit.* (1968) 15, *op. cit.* (1982) 313; Meijer & Wood *op. cit.* 261; Burgess *op. cit.* 101; Anderson *op. cit.* (1980) 112; PROSEA *op. cit.* 182; Coode *et al.* (eds.) *op. cit.* 69; Newman *et al. op. cit.* 106. **Type:** *Lowe s.n.*, Borneo, Labuan (holotype K). **Synonym:** *Dipterocarpus undulatus* Vesque *op. cit.* 153.

Large emergent tree, to 55 m tall, to 2 m diameter; crown spreading, rather flat, diffuse, large-leaved; buttresses to 2.5 m tall, prominent. **Bark** chocolate-brown, thinly evenly flaky and vertically cracked. *Twigs*, *midrib and vein below more or less densely caducously pale golden-yellow pubescent*; *exposed parts of buds*, *ovary*, *stipule outside*, *and inflorescence persistently so.* **Twigs** *to 10 × 3 mm across apically*, *compressed*, *stout*, with broad swollen stipule scars. *Leaf buds* conical to falcate, *c.* 15 × 9 mm, obtuse, *pale golden-yellow pubescent*. **Stipules** deltoid, to 4 × 3 cm. **Leaves** thickly coriaceous, *prominently corrugated*, *drying pale brown and more or less glabrous below*; *blade ovate-lanceolate*, 15–20 × 6–10 cm, base obtuse to cordate, *margin prominently revolute*, apex obtuse to narrow-acuminate with an acumen to 0.6 cm long; *lateral veins 15–20 pairs*, prominent and glabrous below; *petiole 1.5–3 cm long*, *stout.* **Inflorescences** to 3 cm long, stout, terminal or axillary, simple or singly branched. **Flowers:** buds to 4 × 1.2 cm; stamens *c.* 30, anthers narrowly oblong. **Fruits:** *calyx tube globose*, *c. 4 × 4 cm*, *including the 5 intricately convoluted flanges*; 2 major calyx lobes to 14 × 3.5 cm, 3 minor ones broadly ovate, to 2 × 2 cm, recurved and concurrent with flanges.

Vernacular name. Sabah and Sarawak—*keruing sol/shol* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known in Sabah from Beaufort, Kinabatangan, Lahad Datu, Sipitang, Tawau, and Tenom districts (e.g., *SAN 15013*, *SAN 15119*, *SAN 36004*, *SAN 37834*, and *SAN 40611*) and in Sarawak from Baram, Bintulu, Kuching, Lawas, Limbang, and Lundu districts (e.g., *S 1826*, *S 9097*, *S 10068*, *S 16944*, and *S 42981*). Also occurring in Brunei (e.g., *BRUN 3285*, *FMS 35657* and *Wong WKM 1610*) and C, SE and E Kalimantan (e.g., *Argent 9485*, *bb. 18329* and *Meijer 2552*).

Ecology. Local but common where it occurs, in mixed dipterocarp forest on low sedimentary hills on yellow sandy soils, at altitudes to 400 m. In many localities in Sabah and Sarawak, it also occurs on ultrabasic rocks. Locally frequent in Lambir and Mulu NPs, elsewhere vulnerable.

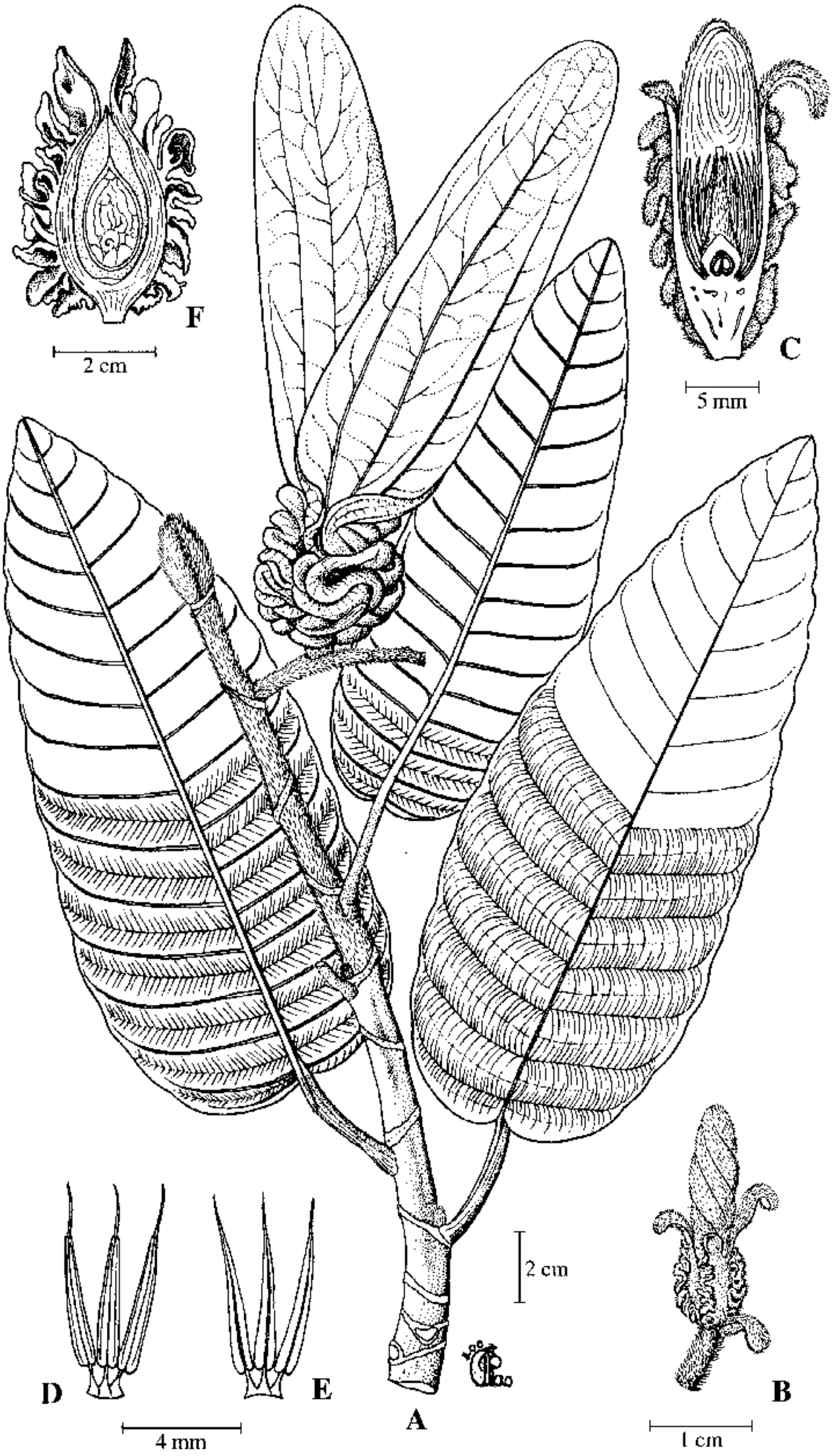

Fig. 8. *Dipterocarpus lowii*. A, fruiting leafy twig; B, flower bud; C, longitudinal section of flower bud; D, adaxial view of stamens; E, abaxial view of stamens; F, longitudinal section of fruit. (A from *SAN 40611*, B–E from *S 10068*, F from *S 1826*.)

27. **Dipterocarpus mundus** Slooten

(Latin, *mundus* = elegant; the neat appearance of the glabrous parts)

Bull. Jard. Bot. Buitenz. 3, 16 (1940) 446; Masamune *op. cit.* 487; Ashton *op. cit.* (1968) 15, *op. cit.* (1982) 319; Anderson *op. cit.* (1980) 112; PROSEA *op. cit.* 183; Newman *et al. op. cit.* 107. **Lectotype** (here designated)**:** *bb. 26033*, Kalimantan, Melawi, Bt. Ransah, Catit (hololectotype BO; isolectotype KEP).

Emergent tree, to 50 m tall, to 1 m diameter. *Parts glabrous but for the inner surface of stipules*. **Twigs** 2–3 mm diameter apically, slender. *Leaf buds linear-falcate*, *to 14 × 3 mm*, *glabrous outside*, *drying black*. **Stipules** linear, to 4 × 0.6 cm. **Leaves** thinly coriaceous, drying rich brown below; *blade narrowly elliptic to obovate*, 5.5–16 × 2.5–7.5 cm, *base narrowly obtuse*, apex with tapering acumen to 0.8 cm long; *lateral veins 8–10 pairs*, slender but prominent below; *petiole 1.6–3 cm long*, *slender*. **Inflorescences** to 6 cm long, axillary, unbranched. **Flowers:** buds to 2 × 0.8 cm; *stamens c. 15*, anther narrowly oblong. **Fruits:** pedicels *c.* 3 mm long; *calyx tube glabrous*, *narrowly ellipsoid or narrowly obovoid*, *to 3 × 1.2 cm*, *with 5*, *rigid flanges to 7 mm wide*, *widest in the distal half*; 2 major calyx lobes to 11 × 2.7 cm, 3 minor ones broadly ovoid, to 0.8 × 0.8 cm, obtuse, somewhat recurved.

Vernacular name. Sarawak—*keruing matang* (preferred name).

Distribution. Endemic in Borneo and known only from the central mountains of the Kapuas and Rajang hinterlands. In Sarawak recorded from Kapit and Miri districts (e.g., Ashton *s.n.*, *S 19046*, *S 29648*, *S 29649*, and *S 57980*). Also occurring in W Kalimantan (e.g., *bb. 27022*, *bb. 28135* and *bb. 29650*).

Ecology. In Sarawak, scattered in mixed dipterocarp forest in small groups along the narrow sandstone and shale ridges of the Rajang Series, on shallow clay-rich soils, at 400–600 m altitude. Vulnerable.

28. **Dipterocarpus nudus** Vesque

(Latin, *nudus* = naked; the glabrous parts)

C. R. Ac. Sci. Paris, 78 (March 1874) 150; Merrill *op. cit.* (1921) 399; Slooten *op. cit.* (1927) 325; Masamune *op. cit.* 487; Browne *op. cit.* 110; Ashton *op. cit.* (1964) 38, *op. cit.* (1968) 16, *op. cit.* (1982) 320; Anderson *op. cit.* (1980) 113; Coode *et al.* (eds.) *op. cit.* 69; Newman *et al. op. cit.* 108. **Type:** *Beccari PB 2905*, Borneo, Sarawak, G. Matang (holotype P). **Synonym:** *Dipterocarpus pentapterus* Dyer, J. Bot. 12 (April 1874) 106 & 152.

Emergent tree, to 50 m tall, to 1.3 m diameter; bole frequently malformed; crown dark and dense, somewhat flat. **Bark** typical. *Parts glabrous but for the buff-pubescent ovary apex and inner surface of stipules*. **Twigs** 2–3 mm diameter apically, slender. *Leaf buds linear-falcate*, 15–30 × 2–3 mm, *drying black*. **Stipules** linear, to 6 × 0.5 cm. **Leaves** *thinly coriaceous*, *hardly corrugated*, drying chocolate-brown below; *blade more or less narrowly elliptic*, 11–14 × 4–6 cm, base cuneate or narrowly obtuse, margin undulate and somewhat sinuate distally, apex with slender acumen to 0.6 cm long; *lateral veins* (*8–*)*11–14 pairs*, dense, ascending, slender but prominent below; *intercostal venation widely scalariform to subreticulate*; *petiole 2.5–4.5 cm long*, *slender*. **Inflorescences** to 18 cm long, terminal or axillary, singly branched, zig-zag. **Flowers:** buds to 4 × 0.9 cm, slender; stamens *c.* 15, anther narrowly oblong, tapering. **Fruits:** *calyx tube glabrous*, *narrowly ellipsoid to* *spindle-shaped*, *c. 2.5 × 1 cm*, *with 5*, *rigid flanges to 3 mm wide*; 2 major calyx lobes to 9.5 × 3 cm, 3 minor ones *c.* 0.4 × 0.4 cm, obtuse, subrevolute.

Vernacular name. Sarawak—*keruing licin* (preferred name).

Distribution. Endemic in Borneo. Known in Sarawak from Bintulu, Kapit, Kuching, Mukah, Limbang, Lundu, Simunjan, Sri Aman, and Tatau districts (e.g., *S 6501*, *S 9481*, *S 9613*, *S 10303*, *S 13764*, and *S 29552*). Also occurring in Brunei (e.g., *BRUN 727*, *BRUN 773*, *BRUN 3095*, and *BRUN 3193*).

Ecology. Widespread but uncommon in mixed dipterocarp forest on hills, at altitudes to 600 m, on yellow sandy soils and on shallow shale derived silty clays. Vulnerable.

Notes. In the western part of its range this species has broader more coriaceous leaves, with narrowly obtuse base and 8–12 pairs of lateral veins (as compared with 12–14 pairs of lateral veins in its eastern range). They differ from one another almost as much as both do from *D. mundus.*

29. **Dipterocarpus oblongifolius** Blume Plates 2D–F.

(Latin, *oblongus* = rather long, *folius* = leaf; with oblong leaves)

Mus. Bot. Lugd.-Bat. 2 (1852) 36; King *op. cit.* 95; Merrill *op. cit.* (1921) 399; Ridley *op. cit.* (1922) 216; Slooten *op. cit.* (1927) 338; Masamune *op. cit.* 487; Symington *op. cit.* (1943) 184; Browne *op. cit.* 110; Ashton *op. cit.* (1964) 39, *op. cit.* (1968) 16, *op. cit.* (1982) 317; Meijer & Wood *op. cit.* 364; Burgess *op. cit.* 101; Anderson *op. cit.* (1980) 113; PROSEA *op. cit.* 183; Coode *et al.* (eds.) *op. cit.* 69; Newman *et al. op. cit.* 109. **Type:** *Korthals s.n.* (= *RHL Sheet Nos. 902146156–159*), Borneo, Kalimantan (holotype L). **Synonyms:** *Dipterocarpus stenopterus* Vesque *op. cit.* 625; *D. pulcherrimus* Ridl., Trans. Linn. Soc. Bot. 3 (1893) 283.

Stout trunked leaning tree, to 30 m tall, to 1.5 m diameter; bole elliptic in cross-section towards base, branching low; crown spreading, with hanging branch endings, dark green shiny leaves and conspicuous apple-red young leafy shoots. **Bark** pale greyish brown, thinly irregularly flaked. *Exposed living parts and ovary*, *leaf surface and veins above excepted*, *densely evenly pale cream-yellow pubescent*, *persistent only on stipule outside*, *calyx and ovary*. **Twigs** *2–3 mm diameter apically*, *slender*. *Leaf buds linear*, *c. 20 × 3 mm*, *compressed*, *glabrous or densely tomentose*, *drying yellowish brown or black*. **Stipules** lorate, to 15 × 1.5 cm, obtuse. **Leaves** thinly coriaceous, *glabrous*, drying greyish brown; blade narrowly elliptic to lanceolate, 14–18(–25 in juveniles) × 4–7(–9) cm, base cuneate, apex tapering to 1 cm slender acumen; *lateral veins 16–20 pairs*, *slender*; *petiole 1.7–2 cm long*, *slender*. **Inflorescences** to 18 cm long, terminal or axillary, simple or singly branched. **Flowers:** buds *c.* 4 × 1 cm; stamens *c.* 15, anthers narrowly oblong, tapering. **Fruits:** pedicels to 2 mm long; *calyx tube densely pale buff-pubescent*, *narrowly ovoid to spindle-shaped*, *to 3 × 0.9 cm*, *only slightly constricted at neck*, *with 5*, *c. 1 mm wide wavy flanges from base to apex*; 2 major calyx lobes to 12 × 1.5 cm, 3 minor ones narrowly deltoid, *c.* 1 × 0.3 cm, recurved.

Vernacular names. Sabah—*keruing neram* (preferred name). Sarawak—*ensurai* (Iban), *gansurai* (Iban), *laran* (Kayan).

Distribution. Peninsular Thailand, Peninsular Malaysia and Borneo. In Sabah widespread and known from Beaufort, Beluran, Labuk Sugut, Ranau, Sandakan, Sipitang, Tawau, and Tenom districts (e.g., *SAN 5498*, *SAN 6726*, *SAN 24959*, *SAN 69924*, and *SAN 95397*) and in Sarawak from Belaga, Betong, Bintulu, Kapit, Lawas, Limbang, Marudi, Miri, Song, and Sri Aman districts (e.g., *S 15451*, *S 29568*, *S 56490*, *S 57497*, and *S 64888*). Also occurring in Brunei (e.g., *BRUN 353*, *BRUN 401*, *FMS 39607*, *KEP 80118*, and *Wong WKM 1156*) and Kalimantan (e.g., *bb. 20633*, *Kostermans 12664*, *Mogea 3548*).

Ecology. Gregarious along the banks of white water rivers, on stable soils over bedrock, below flood and above normal river level, at altitudes to 400 m. Frequently flowering and fruiting, the masses of pink calyces a glory of the inland rivers. Occurring in Mulu NP; decimated in many areas outside the park but not yet vulnerable.

30. **Dipterocarpus ochraceus** Meijer

Acta Bot. Neerl. 12 (1963) 351; Meijer & Wood *op. cit.* 26; Burgess *op. cit.* 100; Ashton *op. cit.* (1982) 325; Newman *et al. op. cit.* 110. **Type:** *Meijer SAN 24200*, Borneo, Sabah, Ranau district, Bt. Kulang (holotype K; isotypes KEP, L, SAN).

Medium-sized emergent (large for its habitat) tree, to 45 m tall, to 1.2 m diameter. **Bark** rust-brown, becoming coarsely irregular-flaky. *Young parts densely ochreous velutinous, persistent on buds, stipule outside and twigs*; *becoming sparse on petiole and venation below*; *caducous elsewhere*. **Twigs** *c.* 4 mm diameter apically, *stout*. *Leaf buds ovoid-lanceolate*, to 20 × 8 mm. **Leaves** coriaceous, *corrugated*, *sparsely pubescent and drying pale yellowish brown below*; *blade broadly elliptic-ovate*, *10–19 × 4.5–9.5 cm*, base cuneate or rarely obtuse, *apex acute with acumen to 1.5 cm long*; *lateral veins 11–15 pairs*, slender but prominent below; intercostal venation dense, elevated below; *petiole 1.5–2.5 cm long*. **Inflorescences** and **flowers** unknown. **Fruits:** pedicels to 3 × 2 mm, prominent; *calyx tube glabrescent*, *broadly ellipsoid*, *to 1.8 × 1.5 cm*, *with 5*, *to 2 mm wide continuous rigid flanges*; 2 major lobes to 8 × 1.5 cm, 3 minor ones ovate, to 0.6–3 × 0.6 cm, subrevolute.

Vernacular name. Sabah—*keruing ranau* (preferred name).

Distribution. Endemic in Borneo; recorded only in Sabah from Bt. Kulong and Bt. Tampurango, Ranau district (e.g., *SAN 20670*, *SAN 22353*, *SAN 22371*, and the type).

Ecology. In scattered groups along ridges in upper dipterocarp forest, at 600–700 m altitude, on the ultrabasic and basic volcanic mountains of the Kinabalu flanks but mainly outside the National Park boundary. Endangered.

31. **Dipterocarpus pachyphyllus** Meijer

(Greek, *pachys* = thick, *phullon* = leaf; with thick leaf texture)

Acta Bot. Neerl. 12 (1963) 351; Meijer & Wood *op. cit.* 265; Burgess *op. cit.* 101; Ashton *op. cit.* (1964) 41, *op. cit.* (1968) 16, *op. cit.* (1982) 313; Anderson *op. cit.* (1980) 113; Coode *et al.* (eds) *op. cit.* 69; Newman *et al. op. cit.* 111. **Lectotype** (designated here)**:** *G.H.S. Wood SAN 15100*, Borneo, Sabah, Padas Gorge (hololectotype K; isolectotypes KEP, L, SAN).

Emergent tree, to 45 m tall, to 1.2 m diameter; crown becoming flat; buttresses to 1 m tall. **Bark** pale chocolate-brown, vertically cracked and evenly flaky. *Young parts at first evenly shortly pale yellowish brown pubescent*, *fugaceous on all but exposed parts in bud*, *outside of stipules*, *ovary apex*, *and inflorescence*. **Twigs** *to 4 × 2.5 mm apically*, *compressed*, *slender*, with prominently raised stipule scars. Leaf buds linear-falcate, *c.* 18 × 4 mm. **Stipules** narrowly deltoid, *c.* 4 × 1.2 cm. **Leaves** thickly coriaceous, *hardly corrugated*, *drying yellowish brown and glabrous below*, somewhat shiny; *blade broadly ovate*, 9–17 × 5–9 cm, base obtuse to subcordate, *margin hardly revolute*, apex with broad acumen to 1 cm long; *lateral veins 10–12 pairs*, distant, prominent below, coalescing to an indistinct intramarginal vein; *petiole 2–3.4 cm long*, *to 2 mm diameter*, *slender*, prominently geniculate. **Inflorescences** to 5 cm long, terminal or axillary, simple. **Flowers:** buds to 1.5 × 0.5 cm; stamens 23–25, anther narrowly oblong. **Fruits:** *calyx pruinose*, *tube subglobose*, *to 2.5 × 2 cm*, *including the 5 tightly convoluted flanges*; 2 major calyx lobes to 13 × 3 cm, 3 minor ones broadly deltoid, to 1 × 1.5 cm, recurved.

Vernacular names. Sabah—*keruing daun tebal* (preferred name). Sarawak—*keruing sol padi* (preferred name).

Distribution. Endemic in Borneo. In Sabah widespread and known from Beaufort, Keningau, Kinabatangan, Lahad Datu, Sandakan, Sipitang, Tawau, and Tenom districts (e.g., *KEP 80471*, *SAN 15053*, *SAN 16433*, *SAN 16473*, and *SAN 93675*) and in Sarawak from Bintulu, Kapit, Marudi, Miri and Tatau districts (e.g., *Hotta 15812*, *S 22032*, *S 22043*, and *S 22715*). Also occurring in Brunei (e.g., *BRUN 365* and *S 1671*).

Ecology. Scattered in mixed dipterocarp forest on leached clay soils on low hills and slopes, at altitudes to 400 m. Occurring in Mulu NP, elsewhere vulnerable.

32. **Dipterocarpus palembanicus** Slooten

(of Palembang, Sumatra)

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 336; Symington *op. cit.* (1943) 185; Ashton *op. cit.* (1968) 16, *op. cit.* (1982) 318; PROSEA *op. cit.* 184; Newman *et al. op. cit.* 113. **Lectotype** (Ashton, 1978)**:** *bb. T.134*, *Feb. 1924*, Sumatra, Palembang, Lematang Hilir, near G. Megang (hololectotype BO; isolectotypes KEP, L).

Emergent tree, to 50 m tall, to 1.2 m diameter; crown compact, dense, hemispherical. **Bark** at first rich orange-brown, becoming irregularly flaky. **Twigs** *terete*, *2–3 mm diameter apically*, finely cracked and flaky. *Leaf buds ellipsoid-ovoid or broadly ovoid*, *c.* 7 × 4 mm, obtuse, *densely golden- to rust-tomentose*. **Stipules** narrowly hastate, to 3 cm long. **Leaves** *thinly coriaceous*, somewhat corrugated, *drying pinkish brown and glabrous below*; blade elliptic to ovate and 10–14 × 5–9 cm, or oblong-ovate and 7–11 × 3–6 cm, base obtuse or cuneate, margin sinuate, apex with slender acumen to 2 cm long; *lateral veins 12–14 pairs*, slender but prominent below, rather dense; intercostal venation dense; *petiole 2–3 cm or to 1.5 cm long*, *to 2 mm diameter*, pubescent. **Inflorescences** to 6 cm long, terminal or axillary, unbranched or singly branched. **Flowers:** buds *c.* 3.5 × 1.5 cm; *stamens c. 15*, anther linear-tapering. **Fruits:** *calyx glabrous*, *pruinose*, *tube narrowly ellipsoid*, *to 3.5 × 1.5 or 5.5 × 2 cm*, *tapering towards each end*, *with 5 broad thin flanges from base to apex*, *obtuse to subcordate at base or the flanges to 15 mm wide*, *undulate*, *auriculate at base and apex*; 2 major calyx lobes to 10 × 3.5 cm, revolute and subcordate at base, 3 minor ones broadly orbicular, to 0.5 × 1 cm, recurved and with revolute undulate margins.

Vernacular name. Sabah—*keruing palembang* (preferred name).

Distribution. Sumatra, Peninsular Malaysia, Singapore and Borneo.

Notes. Two subspecies, *viz*. subsp. *borneensis* and subsp. *palembanicus* are recognised in Borneo.

Key to subspecies

Twigs, leaf buds and stipules outside densely fulvous hispid; petiole, midrib above and leaf blade below densely short-pubescent, caducous on twigs and petiole, otherwise persistent. Leaf blade elliptic to ovate, 10–14 × 5–9 cm; petiole 2–3 cm long. Fruit calyx tube to 3.5 × 1.5 cm, flanges to 8 mm wide, obtuse to subcordate at base………………………………….

subsp. **palembanicus**

As the species. In Borneo recorded from Kuching, Kapit and Miri districts in Sarawak (e.g., *S 22678*, *S 39095*, *S 46438*, *S 46529*, and *S 68426*). Locally frequent along ridges in mixed dipterocarp forest, at altitudes to 600 m. Occurring in Lambir NP, elsewhere vulnerable.

Twigs, petiole, midrib on both sides and lateral veins below densely reddish brown pubescent, caducous on twigs, persistent and long on leaf buds, stipules and petiole. Leaf blade oblong to ovate, 7–11 × 3–6 cm; petiole to 1.5 cm long. Fruit calyx tube to 5.5 × 2 cm, flanges to 15 mm wide, undulate, auriculate at base and apex…………………………...

subsp. **borneensis** P.S.Ashton

(of Borneo)

Gard. Bull. Sing. 31 (1978) 12, *op. cit.* (1982) 319; Anderson *op. cit.* (1980) 113; PROSEA *op. cit.* 184; Coode *et al*. (eds.) *op. cit.* 69; Newman *et al. op. cit.* 114. Type: *G.H.S. Wood SAN A 1747*, Borneo, Sabah, Beaufort district (holotype L; isotypes KEP, SAN).

Endemic in Borneo, and recorded from Beaufort, Kinabatangan, Labuk Sugut, Sandakan, and Tawau districts in Sabah (e.g., *SAN 16452*, *SAN 17772*, *SAN 26890*, and *SAN 28102*) and from Belaga, Bintulu and Kapit districts in Sarawak (e.g., *S 14719*, *S 15101*, *S 22204*, *S 23828* and *S 32309*). Also occurring in Brunei (e.g., *BRUN 2617* and *BRUN 5742*), and C and E Kalimantan (e.g., *Wilkie 94310*). In mixed dipterocarp forest on clay-rich soils over sedimentary rocks, on ridges, at altitudes to 600 m. Occurring in Lambir NP, elsewhere vulnerable.

33. **Dipterocarpus rigidus** Ridl.

(Latin, *rigidus* = stiff; the leaf blade)

J. Str. Br. Roy. As. Soc. 82 (1920) 171, *op. cit.* (1922) 217; Slooten *op. cit.* (1927) 347, *op. cit.* (1961) 463; Masamune *op. cit.* 488; Symington *op. cit.* (1943) 186; Browne *op. cit.* 110; Ashton *op. cit.* (1968) 16, *op. cit.* (1982) 310; Anderson *op. cit.* (1980) 113; PROSEA *op. cit.* 185; Newman *et al. op. cit.* 114. **Type:** *Foxworthy 1190*, Peninsular Malaysia, Johor, Endau, Sg. Maoung (holotype K).

Large emergent tree, to 50 m tall, to 1 m diameter; crown golden brown from below, dense. **Bark** rust-brown, vertically cracked and shallowly patchily flaked. *Twig*, *petiole*, *midrib above*, *blade undersurface*, *petal outside*, *and ovary apex shortly densely evenly ochreous-yellow pubescent*, *blade above fugaceously so*; *leaf bud and stipule outside longer tomentose*; *parts otherwise glabrous.* **Twigs** *c.* 8 mm diameter apically, stout. Leaf buds conical, to 15 × 8 mm, acute. **Stipules** lorate, *c.* 7 × 1 cm. **Leaves** *thickly coriaceous*, *corrugated*; *blade ovate*, *13–25 × 8–16 cm*, base broadly cuneate, apex with broad acumen to 1 cm long; *lateral veins 12–16 pairs*, with midrib stoutly prominent below, somewhat sunken above; *petiole 3–6 cm long*. **Inflorescences** to 15 cm long, glabrescent, usually unbranched. **Flowers:** buds *c.* 3.5 × 1 cm; stamens *c.* 24, anthers linear-tapering. **Fruits:** pedicels *c.* 10 mm long, stout; *calyx tube subglobose*, *to 5 × 4.5 cm*, *with 5 distal tubercles becoming obscure at maturity*; 2 major calyx lobes to 18 × 5 cm, 3 minor ones suborbicular, to 0.8 × 0.8 cm, revolute.

Vernacular name. Sarawak—*keruing utap* (preferred name).

Distribution. Sumatra (including Riau and Lingga Archipelagoes), Peninsular Malaysia, Anambas Archipelago, and Borneo. In Sarawak known from Bintulu, Kuching, Lawas, and Lundu districts (e.g., *S 10063*, *S 15826*, *S 22056*, *S 27192*, and *S 42985*). Also occurring in C and W Kalimantan (e.g., *bb. 27741 and Yamada K 9536*).

Ecology. In Sarawak, locally common and confined to mixed dipterocarp forest on yellow sandy soils, on low hills not far from the coast. Endangered by forest conversion though present in Bako NP.

Notes. Specimens of juvenile trees of *D. costulatus* and *D. globosus* are sometimes tomentose and difficult to distinguish from those of this species.

34. **Dipterocarpus sarawakensis** F.G. Browne *ex* Slooten Fig. 9.

(of Sarawak)

Reinwardtia 5 (1961) 465; Ashton *op. cit.* (1964) 43, *op. cit.* (1968) 17, *op. cit.* (1982) 323; Anderson *op. cit.* (1980) 69; Coode *et al.* (eds.) *op. cit.* 69; Newman *et al. op. cit.* 116. **Type:** *Mead S 5*, Borneo, Sarawak, Kuching district, Semengoh FR (holotype KEP).

Large emergent tree, to 55 m tall, to 1.2 m diameter; crown hemispherical, with the old leaves turning coppery red before falling. **Bark** orange-brown, irregularly flaked. *Twigs*, *parts exposed in bud*, *stipule outside*, *inflorescence*, *ovary apex*, *midrib on both surfaces*, *and venation below densely persistently golden-brown scabrid-tomentose*; *lateral veins above and intercostal venation below sparsely so*; *blade margin setose*. **Twigs** *c.* 3 mm diameter apically. Leaf buds ovoid, *c.* 8 × 3 mm, acute. **Stipules** narrowly ovate, *c.* 1.5 cm long. **Leaves** thinly coriaceous; *blade broadly obovate*, 5.5–8 × 3.5–5 cm, flat, margin straight and revolute towards the cuneate base, *sinuate towards the obtuse or retuse apex*; *lateral veins 7–8 pairs*, distant, ascending; *petiole 0.7–1 cm*, *stout*. **Inflorescences** to 7 cm long, unbranched or singly branched. **Flowers:** buds to 2.5 × 1.5 cm; *stamens c. 15*, anthers narrowly oblong, relatively short, stout. **Fruits** subsessile; *calyx glabrescent*; *tube spindle-shaped*, *to 2.5 × 1.3 cm*, *broadest towards base*, *tapering towards the ends*, *with 5 papery flanges to 8 mm wide distally*, *tapering to the base or somewhat above it*, *tapering abruptly apically and running into lobes*; 2 major calyx lobes to 9 × 2 cm, 3 minor ones narrowly ovate, to 1.5 × 0.5 cm, acute, revolute.

Vernacular name. Sarawak—*keruing layang* (preferred name).

Distribution. Peninsular Malaysia (East coast, one record) and Borneo. In Sarawak recorded from Bintulu, Kuching, Lundu, and Mukah districts (e.g., *S 9770*, *S 13713*, *S 18097*, *S 23749*, and *S 27194*). Also occurring in Brunei (e.g., *BRUN 928*, *BRUN 5154* and *FMS 37090*) and C Kalimantan.

Ecology. Scattered in mixed dipterocarp forest, rarely frequent in isolated localities on leached sandy and sandy clay soils, on low hills, at altitudes to 400 m. Recorded from Mulu NP but vulnerable, perhaps endangered elsewhere.

35. **Dipterocarpus stellatus** Vesque

(Latin, *stellatus* = star-like; the stellate hairs)

C. R. Ac. Sci. Paris, 78 (March 1874) 626; Merrill *op. cit.* (1921) 400; Slooten *op. cit.* (1927) 335, *op. cit.* (1961) 465; Masamune *op. cit.* 488; Browne *op. cit.* 111; Ashton *op. cit.* (1963) 239, *op. cit.* (1968) 17, *op. cit.* (1982) 323; Anderson *op. cit.* (1980) 113; Newman *et al. op. cit.* 118. **Lectotype** (designated here)**:** *Beccari PB 2555/2907*, Borneo, Sarawak, Matang (hololectotype P). **Synonym:** *Dipterocarpus nobilis* Dyer, J. Bot. 12 (April 1874) 106.

Emergent tree, to 65 m tall, to 1 m diameter; *crown somewhat flat*, *diffuse*; buttresses to 1.5 m tall. **Bark** rich pinkish brown, appearing smooth, with irregular somewhat curled thin flakes. *Young twig*, *leaf bud*, *stipule outside*, *midrib on both surfaces*, *and petiole densely persistently long tufted rust-brown scabrid-tomentose*, *venation below sparsely so*. **Twigs** 2–7 mm diameter apically, ribbed and cracked, with prominent petiole scars. Leaf buds spherical, *c.* 7 × 5 mm. **Stipules** deltoid, *c.* 2 × 0.8 cm. **Leaves** thinly coriaceous, *not concave*; *blade ovate*, 10–25 × 5–16 cm, base cordate or obtuse, *margin not revolute*, *apex with tapering acumen 0.8–1.4 cm long*; *lateral veins 12–16 pairs*, well-spaced; *petiole 2–5 cm long*. **Inflorescences** 10–20 cm long, axillary, unbranched or singly branched. **Flowers:** buds to 6 × 2 cm; stamens *c.* 30; anther linear-tapering, **Fruits** sessile or on short stout pedicels; calyx pruinose, *tube glabrous*, *obturbinate*, *to 5 × 2 cm*, with the nut enclosed in the distal half and the base a slender cylinder, *with 5*, *to 12 mm wide thin undulate flanges from base to apex and concurrent with lobes*; 2 major calyx lobes to 12 × 3 cm, 3 minor ones deltoid, *c.* 1 × 1 cm, with undulate revolute margin.

Vernacular names. Sabah—*keruing bulu* (preferred name). Sarawak—*keruing gunung* (preferred name).

Distribution. Endemic in the northern parts of Borneo.

Notes. Two subspecies, *viz*. subsp. *parvus* and subsp. *stellatus*, are recognised.

Key to subspecies

Twigs to 7 mm diameter apically. Leaf blade 20–25 × 12–16 cm, base cordate, apex with acumen to 1.4 cm long; petiole 2–5 cm long. Inflorescences to 20 cm long…………………. subsp. **stellatus**

In Sarawak recorded from Kuching, Lundu and Serian districts (e.g., *S 7992*, *S 8946*, *S 10182*, and *S 15383*). Also occurring in W Kalimantan (e.g., *Church et al. 1808* and

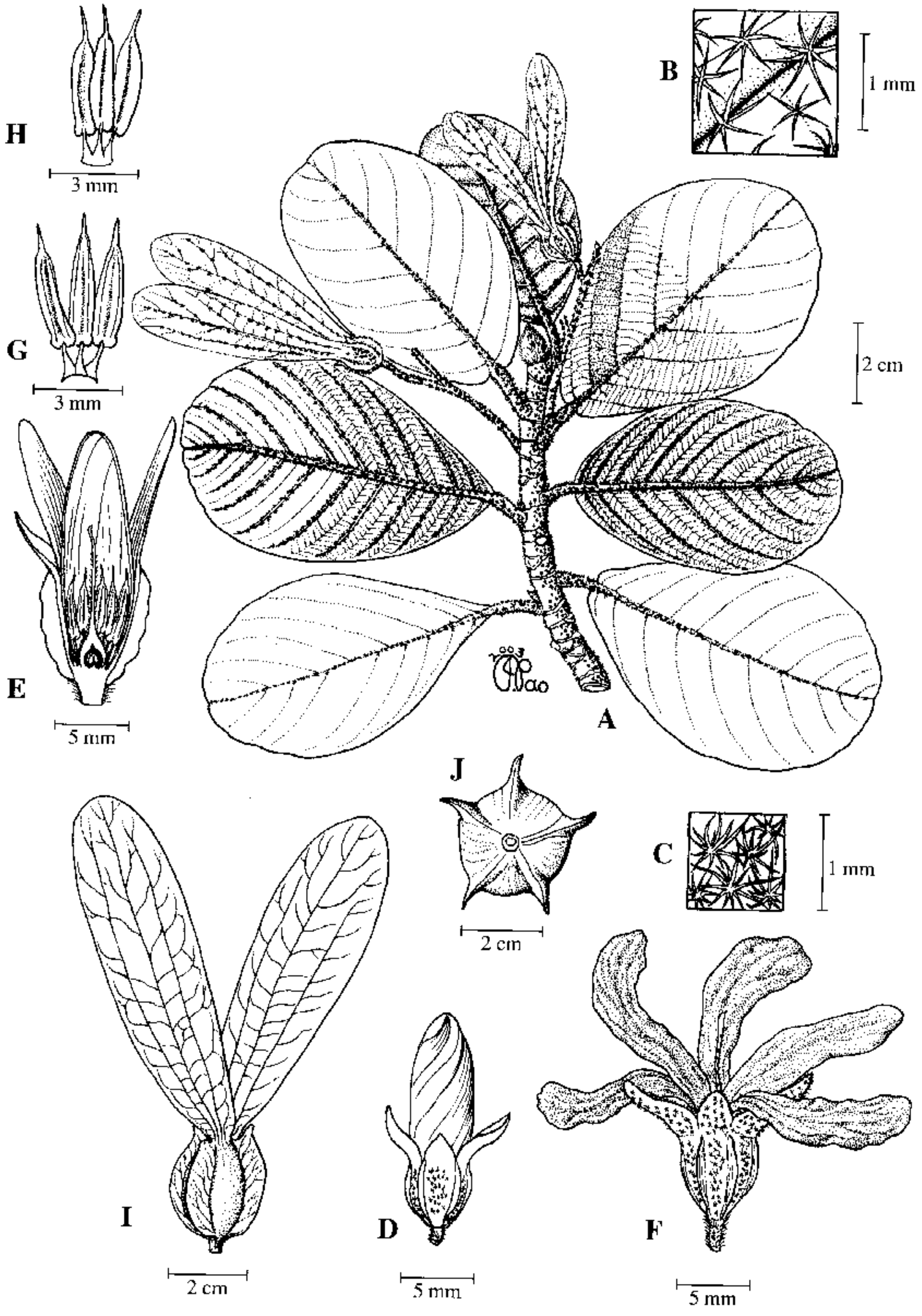

Fig. 9. *Dipterocarpus sarawakensis.* A, fruiting (young) leafy twig; B, detail of indumentum on lower leaf surface; C, indumentum on leaf bud, inflorescence and young fruit; D, flower bud; E, longitudinal section of flower bud; F, open flower; G, adaxial view of stamens; H, abaxial view of stamens; I, mature fruit; J, basal view of mature fruit calyx tube. (A–C from *SA 1288*, D–H from *S 23749*, I–J from *BRUN 5154*.)

Church et al. 1814). Locally common in hill mixed dipterocarp and upper dipterocarp forests on sandy clay soils derived from sandstone and siliceous acid igneous rocks, at altitudes to 800 m. Recorded from G. Gading and Kubah NPs; probably not vulnerable.

Twigs to 2 mm diameter apically. Leaf blade 10–15 × 5–7 cm, base obtuse, apex with acumen to 0.8 cm long; petiole at most 2 cm long. Inflorescences to 10 cm long……………

subsp. **parvus** P.S.Ashton

(Latin *parvus* = small; the vegetative and reproductive parts)

Gard. Bull. Sing. 20 (1963) 239, *op. cit.* (1964) 45, *op. cit.* (1968) 17, *op. cit.* (1982) 323; Meijer & Wood *op. cit.* 268; Burgess *op. cit.* 101; Anderson *op. cit.* (1980) 113; Coode *et al.* (eds.) *op. cit.* 70; Newman *et al. op. cit.* 119. Type: *Ashton BRUN 3176*, Borneo, Brunei, Bangar (holotype K; isotype KEP).

Recorded from Beaufort, Kinabatangan, Sandakan, Sipitang, and Tawau districts in Sabah (e.g., *SAN 15131*, *SAN 15403*, *SAN 24837*, and *SAN A 3126*) and from Belaga, Bintulu, Marudi and Miri districts in Sarawak (e.g., *S 3016* and *S 22057*). Also occurring in Brunei (e.g., *BRUN 3008* and *BRUN 3138*) and E Kalimantan (e.g., *Ambriansyah & Arifin Berau 1061*, *Ambriansyah & Arifin Berau 1089*, *Kessler et al. Berau 690*, and *Kessler et al. Berau 749*). Scattered in mixed dipterocarp forest, on ridges and undulating land, on clay soils derived from shale and acid volcanic rocks, at altitudes to 700 m. Occurring in Lambir and Mulu NPs but vulnerable and possibly endangered elsewhere.

36. **Dipterocarpus sublamellatus** Foxw.

(Latin, *sub* = somewhat, *lamellatus* = layered; the flanges of the fruit calyx tube)

Malay. For. Rec. 10 (1932) 92; Slooten *op. cit.* (1941) 108; Symington *op. cit.* (1943) 189; Meijer & Wood *op. cit.* 269; Ashton *op. cit.* (1968) 17, *op. cit.* (1982) 322; Anderson *op. cit.* (1980) 113; PROSEA *op. cit.* 185; Newman *et al. op. cit.* 119. **Type:** *Watson KEP 6061*, Peninsular Malaysia, Johor, Kluang-Mersing Road (holotype KEP).

Large emergent tree, to 70 m tall, to 3 m diameter; buttresses to 3 m tall and out. **Bark** dark orange-brown, thickly patchily flaky. *Leaf bud and stipule outside densely long pale fulvous hirsute* (rarely glabrous), *ovary shortly so*, *venation below sparsely caducously so*; *parts otherwise glabrous*. **Twigs** *terete*, *c. 3 mm diameter apically*, dark with prominent pale stipule scars. *Leaf buds ellipsoid-ovoid*, to 12 × 8 mm, subacute. **Stipules** lorate, to 4 × 0.8 cm, acute. **Leaves** *coriaceous*, corrugated, *drying chocolate-brown and glabrous below*; blade ovate to elliptic (young trees), 5–15 × 3.5–8 cm, base broadly cuneate, apex with short, slender acumen; *lateral veins 8–12 pairs*, ascending, prominent below; *petiole 1.5(–3) cm long*, *to 2 mm diameter*, *slender*. **Inflorescence:** axillary; rachis to 5 cm long, hardly or not branched, somewhat compressed, few-flowered. **Flowers:** buds to 3.5 × 1 cm; stamens *c.* 24, anther linear-tapering. **Fruits** subsessile; *calyx tube glabrescent*, *globose*, *to 3 × 3 cm*, *with 5*, *to 15 mm wide thickened but undulate flanges tapering into the lobes and auriculate at base*; 2 major calyx lobes to 12 × 3 cm, 2 minor ones suborbicular, to 0.5 × 0.7 cm, revolute.

Vernacular name. Sabah and Sarawak—*keruing kerut* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo recorded in Sabah from Sebatik Is., Tawau district (e.g, *SAN 19627*) and in Sarawak from Bintulu, Kapit and Kuching districts (e.g., *S 6539*, *S 6542*, *S 18428*, and *Sinclair 10296*). Also occurring in Kalimantan (e.g., *Argent 94109*, *Suzuki K 9745* and *Wilkie 94314*).

Ecology. Locally common, on low hills but mostly on periodically flooded sandy clay alluvium, sometimes with shallow peat, at altitudes below 400 m. Vulnerable owing to land conversion.

37. **Dipterocarpus tempehes** Slooten

(*tempehes* = a local name in E Kalimantan)

Reinwardtia 5 (1961) 468; Meijer & Wood *op. cit.* 270; Burgess *op. cit.* 101; Ashton *op. cit.* (1968) 18, *op. cit.* (1982) 297; Anderson *op. cit.* (1980) 113; PROSEA *op. cit.* 185; Kessler & Sidiyasa *op. cit.* 95; Newman *et al. op. cit.* 120. **Type:** *Rutten 126*, Borneo, Kalimantan, Bulungan, Sg. Sajau (holotype U).

Main canopy, occasionally low emergent tree, to 45 m tall, to 1.2 m diameter; buttresses to 2 m tall, 3 m out. **Bark** yellowish brown and dark greenish brown, thinly irregularly flaking. *Twig*, *parts exposed in leaf bud*, *outside of stipules and petals*, *raceme*, *ovary apex*, *and petiole shortly densely persistently pale buff-puberulent*; *leaf venation below and stipule inside sparsely so*; *venation above caducously so.* **Twigs** *terete*, *2–4 mm diameter apically*, *slender*, stipule scars darker than twig. *Leaf buds falcate*, to 12 × 3 mm. **Stipules** lorate, to 8 × 1.2 cm. **Leaves** thickly coriaceous, *corrugated*, drying warm rust-brown, *sparsely pubescent or glabrous below*; *blade broadly elliptic to obovate*, 6–12 × 3.5–8 cm, base broadly cuneate, *apex acute to shortly abruptly acuminate*; *lateral veins 9–12 pairs*, ascending, prominent below; *petiole 1–2 cm long*, to 2 mm diameter. **Inflorescences** to 2.5 cm long, axillary, unbranched. **Flowers:** buds to 3 × 0.8 cm; *stamens c. 30*, anthers narrowly oblong, tapering. **Fruits** subsessile; calyx glabrous; *tube* turbinate, to 4 × 4 cm, lenticellate, *smooth*, *with 5 vestigial lobes round the protruding nut apex.*

Vernacular names. Sabah—*keruing asam* (preferred name). Sarawak—*keruing tempayan* (preferred name).

Distribution. Endemic in Borneo. Known in Sabah from Labuk Sugut, Lahad Datu, Sandakan, and Tawau districts (e.g., *SAN 17792*, *SAN 17794* and *SAN 37891*) and in Sarawak from Bintulu, Kuching, Lawas, and Lundu districts (e.g., *S 14583*, *S 15823*, *S 16580*, *SA 554*, and *SA 659*). Also occurring in S and E Kalimantan (e.g., *Argent & Amiril 93104*, *bb. 10543*, *bb. 17840*, *Kostermans 5274*, and *Kostermans 6211*).

Ecology. Local, but where occurring often common, on clay-rich periodically flooded alluvium, at altitudes below 300 m. Vulnerable, possibly endangered by forest conversion.

38. **Dipterocarpus validus** Blume

(Latin, *validus* = mighty; a big tree)

Mus. Bot. Lugd.-Bat. 2 (1852) 36; Merrill *op. cit.* (1921) 400; Slooten *op. cit.* (1927) 272; Masamune *op. cit.* 488; Ashton *op. cit.* (1963) 237, *op. cit.* (1982) 301; PROSEA *op. cit.* 185; Newman *et al. op. cit.* 122. **Type:** *Korthals s.n.*, Borneo, Kalimantan, G. Sakumbang (holotype L). **Synonyms:** *Dipterocarpus warburgii* Brandis *op. cit.* 32, Slooten *op. cit.* (1927) 305, *op. cit.* (1961) 473, Meijer & Wood *op. cit.* 273, Burgess *op. cit.* 101; *D. affinis* Brandis *op. cit.* 31; *D. lasiopodus* Perkins, Fragm. Fl. Philip. (1904) 22; *D. woodii* Merr., *op. cit.* (1926) 399, Slooten *op. cit.* (1927) 303.

Emergent tree, to 50 m tall, to 1.8 m diameter; crown rather flat, diffuse, large-leaved; buttresses to 2.5 m tall. *Twig*, *leaf bud*, *stipule outside*, *petiole*, *base of inflorescence*, *and ovary apex densely persistently evenly long rufous-tomentose*, *becoming distinctly tufted as the twig and petiole expand*; *lateral veins and midrib below*, *and rest of inflorescence sparsely puberulent.* **Twigs** *terete*, *c. 8 mm diameter apically*, *rather stout*. Leaf buds lanceolate-falcate, to 90 × 13 mm. **Stipules** lorate, to 20 × 3 cm. **Leaves** thinly coriaceous, corrugated, *drying warm brown and glabrous below*; *blade* elliptic-oblong to ovate, *15–25 × 7.5–12 cm* (to 40 × 20 cm in juveniles), base cuneate to obtuse (narrowly peltate in young trees), margin undulate, prominently sinuate distally, apex acute to narrowly acuminate with acumen to 1 cm long; midrib elevated above; *lateral veins 22–28 pairs*, slender but prominent below, dense, shallowly sunken above; *petiole 3.5–5 cm long*, *at least 2 mm diameter*, *stout*. **Inflorescences** to 14 cm long, hardly or not branched, axillary. **Flowers:** buds to 3 × 0.9 cm; *stamens c. 30*, anthers slender, tapering, auriculate. **Fruits:** *calyx tube* turbinate and tapering into pedicel, to 4 × 3.5 cm, *smooth*; *2 major calyx lobes to 25 × 3.5 cm*, *3 minor ones suborbicular*, *to 0.8 × 0.6 cm*, *becoming recurved and revolute.*

Vernacular name. Sabah—*keruing kosugoi* (preferred name).

Distribution. Borneo and the Philippines. In Borneo recorded from Kuala Penyu, Kudat, Kinabatangan, Lahad Datu, Ranau, Tawau, and Tenom districts in Sabah (e.g., *SAN 16402*, *SAN 19551*, *SAN A 2140*, *SAN A 2492*, and *SAN A 4224*) and SE and E Kalimantan (e.g., *bb. 19783* and *Kostermans 6775*).

Ecology. Locally abundant, sometimes gregarious, in lower floodplains behind the mangrove, and near river banks further inland; occasional on low hills on clay-rich soils, at altitudes to 200 m. Endangered by forest conversion.

39. **Dipterocarpus verrucosus** Foxw. *ex* Slooten

(Latin, *verrucosus* = warty; the lenticellate fruit calyx tube)

Bull. Jard. Bot. Buitenz. 3, 8 (1927) 293; Merrill *op. cit.* (1929) 201; Foxworthy *op. cit.* (1932) 71; Masamune *op. cit.* 488; Symington *op. cit.* (1943) 31; Browne *op. cit.* 111; Ashton *op. cit.* (1964) 46, *op. cit.* (1968) 19; Meijer & Wood *op. cit.* 272; Burgess *op. cit.* 101; Anderson *op. cit.* (1980) 113; PROSEA *op. cit.* 186; Coode *et al.* (eds.) *op. cit.* 70; Newman *et al. op. cit.* 123. **Lectotype** (designated here)**:** *Mitchell CF 0313*, Peninsular Malaysia, Selangor, Kajang, Bangi FR (hololectotype KEP; isolectotypes K, L).

Large emergent tree, to 60 m tall, to 1.5 m diameter; crown compact, hemispherical. **Bark** orange-brown, thinly irregularly flaking. *Twig*, *petiole*, *midrib and vein below*, *and flower calyx densely caducously adpressed golden-brown lustrous puberulent*; *leaf bud and inflorescence densely*, *stipule sparsely*, *persistently so*. **Twigs** *c. 2 mm diameter apically*, *terete* or slightly compressed, stipule scars somewhat swollen. *Leaf buds falcate or occasionally conical*, to 12 × 3 mm, *with terminal tuft*. **Stipules** narrowly oblong, to 8 × 0.8 cm, obtuse. **Leaves** coriaceous, *glabrous*, almost flat, *drying distinctive pinkish red below and slightly glazed*; *blade broadly elliptic-ovate*, 6–12 × 3.5–6 cm, base cuneate, apex subacute to broadly acuminate with acumen to 0.5 cm long; *lateral veins 9–14 pairs*, well-spaced, not prominent; intercostal venation well-spaced, somewhat sinuate; *petiole 1.3–2 cm long*, *to 2 mm diameter*. **Inflorescences** to 9 cm long, axillary, unbranched or singly branched. **Flowers:** buds to 2.5 × 1.2 cm; *stamens c. 15*, anthers filiform-tapering. **Fruits** subsessile; *calyx tube ellipsoid-globose*, tapering at base, 1.5–1. 8 × 0.6–0.8 cm, *verrucose-lenticellate*; 2 major calyx lobes to 8 × 1.5 cm, 3 minor ones deltoid, to 0.3 cm long, acute.

Vernacular name. Sabah and Sarawak—*keruing merah* (preferred name).

Distribution. Peninsular Thailand, Peninsular Malaysia and Borneo. In Sabah known from Lahad Datu, Semporna, Sipitang and Tawau districts (e.g., *SAN 15197*, *SAN 17175*, *SAN 18466*, *SAN 43697*, and *SAN 129564*) and in Sarawak from Bau, Belaga, Bintulu, Kapit, Lawas, Limbang, Lundu, Miri, Semarahan, Serian, and Sri Aman districts (e.g., *S 14454*, *S 20291*, *S 22325*, *S 67568*, and *S 76735*). Also occurring in Brunei (e.g., *BRUN 3388* and *BRUN 5743*) and W, C and E Kalimantan (e.g., *Kostermans 13277* and *Wilkie 94305*).

Ecology. A species of shale and volcanic ridges and low hills, at altitudes below 800 m. Curiously rare, even missing in most parts of Borneo but locally common along the high ridges of the Limbang (Sarawak), southernmost Crocker Range (Sabah), and Amo district (Brunei). Occurring in Mulu NP but vulnerable.

4. **DRYOBALANOPS** Gaertn.*f.*

(Greek, *dryas* = a nymph associated with oaks, *balanops* = acorn; the acorn-like nut)

kapur (preferred name)

Fruct. 3 (1805) 49; Foxworthy, Malay. For. Rec. 10 (1932) 103; Slooten, Bull. Jard. Bot. Buitenz. 3, 12 (1932) 1; Symington, Malay. For. Rec. 16 (1943) 191; Wyatt-Smith, Malay. For. 18 (1955) 145; Browne, FTSB (1955) 111; Ashton, MDB (1964) 48, MDBS (1968) 20, FM 1, 9 (1982) 371; Meijer & Wood, Sabah For. Rec. 5 (1964) 276; Burgess, TBS (1966) 117; Anderson, CLTS (1980) 114; PROSEA, 1 (1993) 186; Coode *et al.* (eds.), CLBD (1996) 70; Newman *et al.*, MDFD-MHHW (1998) 125. **Synonyms:** *Pterygium* Correa, Ann. Mus. Nat. Hist. Paris 8 (1806) 397, *p.p.*; *Baillonodendron* F.Heim, Bull. Mens. Soc. Linn. Paris 2 (1890) 867.

Very large emergent trees (except *D. keithii*) with immense cauliflower-shaped crowns, the minor branches numerous, the twigs bunched; buttresses narrowly rounded, often large hardly branching plank. **Bark** yellowish brown, becoming irregularly flaky, sometimes shaggy; inner bark pale brown, uniform, finely fibrous. **Sapwood** pale yellowish brown, darkening gradually toward heartwood. *Parts smelling more or less intensely aromatic of camphor*. Leaf buds small, ovoid, more or less compressed. **Twigs** slender, more or less ribbed owing to the decurrent leaf traces. **Stipules** linear, small, early caducous. **Leaves** coriaceous; blade lanceolate, ovate or oblong, apex prominently slender-acuminate; midrib obscurely sunken above, slender but prominent below; *lateral veins very many*, *very slender and parallel*, *almost straight*, *fusing into a straight intramarginal vein at or close to the margin*, *equal and without intermediates* (*D. keithii*, *D. oblongifolia* excepted), *unraised* (*D. keithii* excepted); *intercostal venation obscure* (*D. keithii* excepted); *petiole slender*, *channelled above*, *not geniculate.* **Inflorescences** *paniculate*, terminal or axillary, lax, few-flowered; bracts and bracteoles minute, fugaceous. **Flowers:** *buds spindle-shaped*, ellipsoid, lanceolate or ovoid, acute or obtuse; sepals equal or subequal, imbricate, united at base into an obconical tube tapering into pedicel; *petals white or cream*, broadly elliptic, subacute, *glabrous*, *hardly contorted in bud*, *connate at base and falling more or less in a rosette*; *stamens c. 30* (*c.* 40 in *D. oblongifolia*), *glabrous*, *subequal or unequal*, *epipetalous*, *filaments broad and compressed*, *connate at base*, broad at base, tapering and filiform distally, anthers bright yellow, large, linear, latrorse, *connectival appendage small*, *stout*, *slightly or hardly exceeding the length of anthers*; ovary small, ovoid, glabrous, *without stylopodium*, *style filiform*, *to 3x the length of ovary*, *stigma minute.* **Fruits:** *calyx with* *incrassate basal cup partially enclosing but free from the nut*, *5 lobes equal to subequal*, *becoming valvate*, *obtuse*, *short or wing-like*, *subrotate*. **Nuts** large, with short apiculate style remnant; pericarp woody, thin, splitting into 3 equal valves at germination; cotyledons reniform, epigeal, on long slender hypocotyl; first two pairs of leaves opposite with short intervening internode. Saplings of Massart's model, that is with more or less horizontal, that is plagiotropic, branches with distichous leaf arrangement clustered in false whorls owing to intermittent growth of the vertical leader (compare, e.g., with *Diospyros*).

Distribution. Confined to W Malesia; seven species in Sumatra, Peninsular Malaysia and Borneo; all occurring in Sabah and Sarawak.

Ecology. Frequently characteristically semi-gregarious, among the most abundant species of the emergent canopy trees, dominating the skyline of the forests they inhabit (*D. keithii* excepted). In mixed dipterocarp, *kerangas* and coastal mixed peat swamp forests on a variety of soils, at altitudes below 800 m. The species flower more frequently than other dipterocarps, and their saplings are generally abundant below parent trees. They are both relatively shade tolerant and relatively fast growing in response to light; characteristics which may help explain the frequent abundance of mature trees.

Uses. The timber, which differs in density and strength between species, is an important moderately heavy and durable construction timber. The camphor obtained from the wood of *D. aromatica* attracted early Arab traders, then being worth more than its weight in gold in the Middle East and used for incense and perfume.

Key to *Dryobalanops* species

(based on all diagnostic characters)

1. Fruit calyx lobes shorter than the nut..…………**6. D. oblongifolia** (subsp. **oblongifolia**)
   Fruit calyx lobes spatulate or oblong-spatulate, longer than the nut….………………..2

2. Leaf blade usually longer than 14 cm; lateral veins distinctly unequal, raised below, obscure and sunken above; margin revolute throughout…….………..…**4. D. keithii**
   Leaf blade shorter than 12 cm; lateral veins subequal, unraised or hardly so below, not sunken above; margin only partially or not revolute…………………………………..3

3. Fruit calyx lobes 0.8–2 cm wide; calyx base fused into a cup to 2 cm diameter and at least 0.5 cm deep…………………………………………………….……………….4
   Fruit calyx lobes to 1.3 cm wide; calyx base fused into a cup not more than 0.8 cm diameter nor deeper than 0.5 cm……………………………………….…………..…5

4. Leaf blade narrowly lanceolate, margin revolute at base……………..…**5. D. lanceolata**
   Leaf blade broadly ovate, not revolute at base……………………….…**1. D. aromatica**

5. Leaf blade 5–8 × 1–3 cm, glabrous……………………………………..….**2. D. beccarii**
   Leaf blade 5–11 × 2–4 cm, more or less tomentose below…………….…………..…..6

6. Tomentum persistent, even, dark golden-brown. Style 3–4x the length of ovary. Nuts ellipsoid-ovoid, to 2 × 1.3 cm…………………………………………….….…**3. D. fusca**
Tomentum more or less caducous, flocculent, rufous. Style 2x the length of ovary. Nuts ovoid, to 1 × 0.6 cm……………………….……………….………………..…**7. D. rappa**

Key to *Dryobalanops* species

(based on field characters)

1. Leaf lateral veins unequal, distinctly raised below, sunken above; leaf margin narrowly revolute throughout. In forest on clay soils in moist valleys……………….…**4. D. keithii**
Leaf lateral veins subequal, more or less unraised below; leaf margin at most partially revolute. In other types of habitats……………….…………………………………….…2

2. Leaf blade more or less tomentose below (saplings sometimes excepted)…………...…3
Leaf blade glabrous……………………………………………………………..…….4

3. Tomentum persistent, even, dark golden-brown. In *kerangas* forest……..…**3. D. fusca**
Tomentum at least partiallly flocculent, rufous, caducous. In peat swamp forest...……...
……………………………………………….…………………………………**7. D. rappa**

4. Leaf blade oblong, or narrowly lanceolate……………………………………………5
Leaf blade ovate-lanceolate to oblong-lanceolate…………………………….………6

5. Leaf blade narrowly lanceolate, margin revolute at base. In mixed dipterocarp forest on clay soils……………………………………………………………....…**5. D. lanceolata**
Leaf blade oblong, margin not revolute at base. In hill forest on moist clay soils and seasonal swamp forest…………………………**6. D. oblongifolia** (subsp. **oblongifolia**)

6. Leaf blade oblong-lanceolate to ovate-lanceolate, thinly coriaceous; lateral veins distinctly paler than blade with distinct fine intramarginal vein visible within margin. Bark dark yellowish tawny. In mixed dipterocarp forest on shallow well-drained soils…………………………………….………………………….…..**2. D. beccarii**
Leaf blade broadly ovate, thickly coriaceous; lateral veins not paler than blade, indistinct; intramarginal vein obscure. Bark warm rust-brown. In mixed dipterocarp forest on deep yellow sands……………………………………………**1. D. aromatica**

1. **Dryobalanops aromatica** Gaertn.*f.*, *nom. cons.* Plates 3A–B.

(Latin, *aromaticus* = spice-like; the smell of the dammar)

Fruct. 3 (1805) 49; Merrill, EB (1921) 401; Foxworthy *op. cit.* 105; Slooten *op. cit.* (1932) 7; Masamune, EPB (1942) 489; Symington, *op. cit.* (1943) 194; Wyatt-Smith *op. cit.* 148; Browne *op. cit.* 114; Ashton, Gard. Bull. Sing. 20 (1963) 241, *op. cit.* (1964) 49, *op. cit.* (1968) 375, *op. cit.* (1982) 375; Meijer & Wood *op. cit.* 278; Burgess *op. cit.* 118; Anderson *op. cit.* (1980) 114; Coode *et al.* (eds.) *op. cit.* 70; Newman *et al. op. cit.* 130. **Type:** *Miller s.n.*, Sumatra, Tapanuli (holotype BM). **Synonyms:** *Arbor camphorifera* Rumph., Herb. Amb. Cap. 82 (1755) 67; *Pterigium teres* Correa, Ann. Mus. Hist. Nat. Paris 10 (1807) 159; *Dryobalanops camphora* Colebr., As. Res. 12 (1816) 535; *Shorea camphorifera* (Rumph.) Roxb., Fl. Ind. ed. Carey 2 (1832) 616; *Dipterocarpus dryobalanops* Steudel, Nom. Bot. ed. 2, 1 (1840) 518; *Dipterocarpus teres* (Correa) Steudel *op. cit.* 518; *Dryobalanops junghuhnii* Becc., Nelle For. Born. (1902) 554; *Dryobalanops vriesii* Becc. *op. cit.* 554;

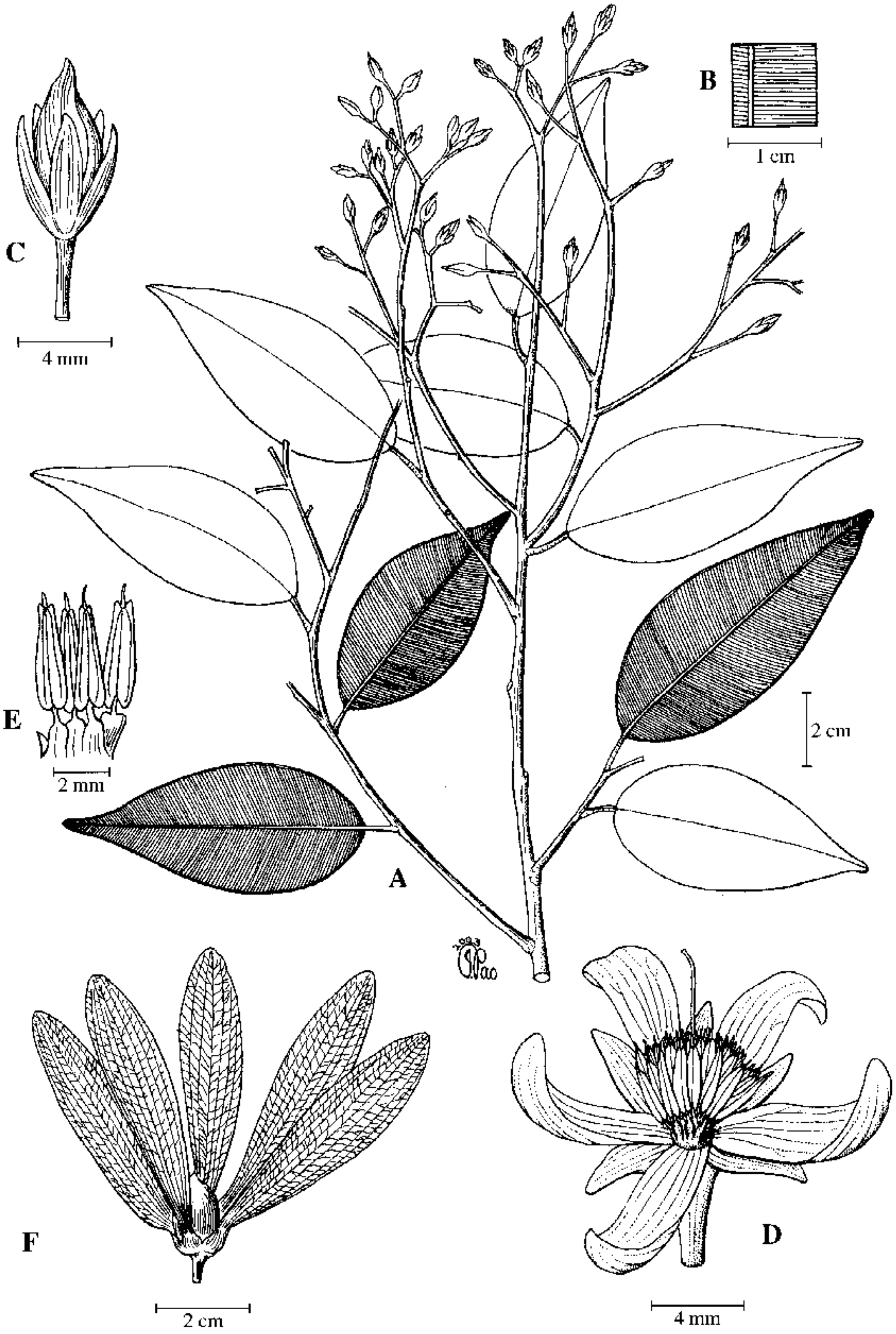

Fig. 10. *Dryobalanops beccarii.* A, flowering leafy twig; B, detail of venation on lower leaf surface; C, flower bud; D, open flower; E, adaxial view of stamens; F, mature fruit. (A–B from *S 23922*, C from *SAN 36331*, D–E from *S 7612*, F from *S 8591*.)

Dryobalanops sumatrensis (J.F. Gmelin) Kosterm., Blumea 33 (1988) 346 (based on *Laurus sumatrensis* J.F. Gmelin, Syst. Veg. (1791 & 1796) 650).

Immense tree, to 65 m tall, to 2 m diameter. **Bark** *warm pale rust-brown*, becoming evenly flaky, later shaggy. All parts strongly aromatic. *Young exposed fleshy parts yellowish lepidote*, *caducous*. **Twigs** *c.* 1 mm diameter apically, smooth, terete, slender. **Leaves** *thickly coriaceous*, *glabrous*; *blade broadly ovate* (*sometimes broader than long*), *4–6 × 2–4 cm*, base cuneate to obtuse, *margin at most only partially revolute*, apex with slender acumen to 1.5 cm long; *lateral veins subequal*, *indistinct*, *not paler than the blade*; *intramarginal veins obscure*; petiole 0.5–1 cm long. **Inflorescences** to 7 cm long; axis angular on drying. **Flowers:** buds spindle-shaped, to 9 × 4 mm; sepals glabrous, lanceolate, obtuse; petals more or less oblong, acute; stamens shorter than the style, filaments slender, tapering, anthers linear, connectival appendage linear, somewhat exceeding anther apex; style *c.* 2x the length of ovary, glabrous. **Fruits** glabrous; *calyx base cup-shaped*, *0.6–0.8 cm deep*, *0.8–1.5 cm diameter*, becoming constricted at the rim; *lobes spatulate*, *obtuse*, *4–6 × 0.8–2 cm*, tapering to 3–5 mm wide at base. **Nuts** ovoid with a short style remnant, to 3 × 1.5 cm, with a constriction at the calyx cup rim.

Vernacular names. Sabah—*kapur barus* (preferred name). Sarawak—*kapur peringgi* (preferred name), *kapur ranggi* (Iban), *keladan* (Iban).

Distribution. Sumatra (including Musala, Lingga and Singkep Is.), Peninsular Malaysia and Borneo. In Borneo recorded in Sabah from Labuk Sugut, Papar and Sipitang districts (e.g., *FMS 35242*, *FMS 35441*, *SAN 15148*, *SAN 50639*, and *SAN A 3298*) and in Sarawak from Bintulu, Kapit, Lawas, Limbang, and Miri districts (*S 1790*, *S 4842*, *S 15104*, *S 22054*, and *S 46493*). Also occurring in Brunei (e.g., *BRUN 508*, *BRUN 3001*, *FMS 34573*, and *Niga NN 228*).

Ecology. Locally the most abundant emergent trees in mixed dipterocarp forest on deep humic yellow sandy soils with a propensity for ridges, at altitudes below 400 m. Vulnerable though abundant in Lambir NP and recorded from Mulu NP.

Notes. The leaves of juveniles are indistinguishable from those of *D. beccarii*, except by the stronger aroma when crushed, being less coriaceous, with distinct venation and visible intramarginal vein.

2. **Dryobalanops beccarii** Dyer Fig. 10, Plate 3C.

(Odoardo Beccari, 1843–1920, Italian explorer and botanist)

J. Bot. 12 (April 1874) 100; Beccari *op. cit.* (1902) 572; Merrill *op. cit.* 401; Slooten *op. cit.* (1932) 36; Masamune *op. cit.* 489; Wyatt-Smith *op. cit.* 149; Browne *op. cit.* 115; Ashton *op. cit.* (1963) 242, *op. cit.* (1964) 51, *op. cit.* (1968) 22, *op. cit.* (1982) 375; Meijer & Wood *op. cit.* 280; Burgess, *op. cit.* 118; Anderson, *op. cit.* (1980) 114; PROSEA, *op. cit.* 191; Kessler & Sidiyasa, TBSA-EK (1994) 95; Coode *et al.* (eds.) *op. cit.* 70; Newman *et al. op. cit.* 131; Chua & Saw, Gard. Bull. Sing. (2003) 1. **Lectotype** (Slooten, 1932)**:** *Beccari PB 2553*, Borneo, Sarawak, Matang (hololectotype K; isolectotype PC). **Synonym:** *Dryobalanops oocarpa* Slooten *op. cit.* (1932) 33, Wyatt-Smith *op. cit.* 155.

Large emergent tree, to 65 m tall, to 2 m diameter. **Bark** *becoming dark yellowish tawny*, prominently irregularly flaky but rarely shaggy. Parts only faintly aromatic. *Exposed young fleshy parts fugaceous puberulent*, *otherwise entirely glabrous*. **Twigs** to 1 mm diameter apically, slender, terete, smooth. **Leaves** *thinly coriaceous*, *glabrous*; *blade ovate-lanceolate to oblong-lanceolate*, *5–8 × 1–3 cm*, base cuneate, *margin at most only partially revolute*, often wavy, apex with slender acumen to 1.7 cm long; *lateral veins subequal*, *usually paler than blade and distinctly visible albeit hardly or not raised*; *intramarginal vein distinct*, *c. 1 mm within margin*; petiole 0.7–1 cm long, very slender. **Inflorescences** to 10 cm long, irregularly doubly branched; axis wrinkled on drying. **Flowers:** buds spindle-shaped, to 10 × 4 mm, acute; sepals equal, narrowly deltoid, subacute; petals broadly elliptic, obtuse; stamens subequal, almost 2/3x the length of style, anthers narrowly oblong, acute, connectival appendage short, erect, slightly exceeding anther; style 2–3x the length of ovary. **Fruits:** *calyx at base with obconical cup to 0.8 cm diameter*, *to 0.5 cm deep*, tapering into pedicel and without constricted rim; *calyx lobes narrowly oblong-spatulate*, *subacute*, *to 6.5 × 0.8 cm*, tapering to 2 mm wide at base. **Nuts** ovoid to globose, acute, to 1.4 cm diameter and long, seated on the small calyx cup thereby pushing the lobes out to a rotate angle.

Vernacular names. Sabah—*kapur merah* (preferred name). Sarawak—*kapur bukit* (preferred name), *keladan* (Iban).

Distribution. Peninsular Malaysia (SE Johor) and Borneo (excepting the southern and southwestern parts). In Borneo, localised in Sabah and recorded from Beaufort, Kinabatangan, Kudat, Labuk Sugut, Pitas, Sandakan, and Sipitang districts (e.g., *KEP 38720*, *KEP 80252*, *SAN 36331*, *SAN 121326*, and *SAN A 4341*) but widespread in Sarawak and recorded from Bau, Bintulu, Kapit, Kuching, Lundu, and Miri districts (e.g., *S 367*, *S 9479*, *S 23867*, *S 28991*, and *S 39768*). Also occurring in Brunei (e.g., *BRUN 3377* and *BRUN 5282*) and W, E and S Kalimantan (e.g., *bb. 26578*, *bb. 29733*, *Kostermans 5995*, and *Kostermans 6782*).

Ecology. In mixed dipterocarp forest, locally among the most abundant emergent trees, elsewhere scattered; on shallow leached soils over both sandstone and shale on high narrow ridges, at altitudes to 700 m. Particularly abundant on coastal sandstone formations, including near the mouths of Sabah east coast rivers but also on seasonally swamped alluvium there; locally common on the high narrow inland ridges from G. Menuku, the Klingkang Range, Bako and Mulu NPs in Sarawak to the Crocker Range in W Sabah. Though its habitat is greatly reduced by logging, the species is probably not yet vulnerable.

3. **Dryobalanops fusca** Slooten

(Latin, *fuscus* = dark-coloured; the indumentum)

Bull. Jard. Bot. Buitenz. 3, 12 (1932) 39; Masamune *op. cit.* 489; Wyatt-Smith *op. cit.* 150; Ashton *op. cit.* (1968) 22, *op. cit.* (1982) 377; Anderson *op. cit.* (1980) 114; PROSEA *op. cit.* 191; Newman *et al. op. cit.* 133. **Lectotype** (designated here)**:** *bb. 11468*, Borneo, Kalimantan, Sambas, Paloh (hololectotype BO).

Emergent tree, to 60 m tall, to 1.5 m diameter; bole frequently misshapen; crown distinctly coppery from below. **Bark** *becoming dark golden-brown*, irregularly coarsely flaking. *Exposed fleshy parts*, *leaf blade*, *flower and fruit excepted*, *densely shortly evenly persistently pale rufous-brown tomentose*; *blade undersurface similarly golden-brown* *tomentose*. **Twigs** *c.* 1–2 mm diameter apically, slender, much-branched. **Leaves** coriaceous; blade broadly lanceolate, *5–10 × 2–4 cm*, base obtuse to broadly cuneate, *margin not or only partially revolute*, apex subcaudate with acumen to 1.5 cm long; *lateral veins subequal*, *more or less unraised below*; intercostal venation obscured by tomentum; petiole 0.5–1 cm long. **Inflorescences** singly branched; axis terete, to 5 cm long. **Flowers:** buds lanceolate, to 12 × 3 mm; sepals equal, narrowly lorate-deltoid, obtuse; petals lanceolate; stamens reaching below style apex, filaments *c.* 2/3x the length of anthers, anthers narrowly oblong, tapering, connectival appendage erect, extending somewhat above anther apex; *style 3–4x the length of ovary*. **Fruits** glabrous; pedicels to 6 mm long, prominent; *calyx cup shallow*, *to 0.3 cm deep*, *to 0.7 cm diameter*; *calyx lobes spatulate*, *obtuse*, *to 6 × 1.3 cm*, tapering to 4 mm wide at base. **Nuts** *ellipsoid-ovoid*, *apiculate*, *to 2 × 1.3 cm*.

Vernacular name. Sarawak—*kapur empedu* (preferred name).

Distribution. Endemic in Borneo; recorded from Bintulu and Lundu districts in Sarawak (e.g., *S 2451*, *S 7999*, *S 9625*, and *S 18629*) and from W Kalimantan (e.g., *bb. 8895*, *bb. 11352* and *bb. 14514*).

Ecology. Locally once the commonest emergent tree in *kerangas* forest, usually on raised beaches, at altitudes to 200 m. Rare and endangered.

4. **Dryobalanops keithii** Symington Fig. 11.

(H.G. Keith, 1899–?, one time Conservator of Forests in Sandakan)

Gard. Bull. S. S. 10 (1939) 379; Slooten, Bull. Jard. Bot. Buitenz. 3, 16 (1940) 449, Reinwardtia 5 (1961) 475; Masamune *op. cit.* 489; Wyatt-Smith *op. cit.* 151; Meijer & Wood *op. cit.* 283; Burgess *op. cit.* 118; Ashton *op. cit.* (1982) 373; PROSEA *op. cit.* 191; Newman *et al*. *op. cit.* 134. **Type:** *Keith FMS 44382*, Borneo, Sabah, Tawau district, Tiaggau, Kalabakan (holotype KEP; isotype KEP).

Main canopy to low emergent tree, to 40 m tall, to 2 m diameter; bole frequently misshapen; buttresses small and few. **Bark** smooth or eventually thinly flaky, pale ochreous-brown. *Outside of calyx and inflorescence fugaceous puberulent*; *parts otherwise glabrescent.* **Twigs** at first *c.* 2 mm diameter apically, verrucose-lenticellate, becoming smooth. **Leaves** coriaceous; *blade* narrowly oblong, lanceolate or oblanceolate, *14–33 × 5–10 cm*, base obtuse to cordate, *margin narrowly revolute throughout*, apex with slender acumen to 1 cm long; *lateral veins unequal*, many and parallel but well-spaced, with prominent intermediate veins, arched within margin forming a distinct intramarginal vein, *slender but prominently raised below*, *obscurely sunken above*; intercostal venation visible but indistinct, reticulate; petiole 0.7–1.2 cm long, stout. **Inflorescences** terminal or subterminal-axillary, singly or doubly branched, to 14 cm long. **Flowers:** buds ellipsoid, to 10 × 4 mm, acute; sepals narrowly deltoid, subacute; petals ovate, acute; stamens subequal, slightly shorter than style, filaments *c.* half the length of anthers, anthers linear, tapering, connectival appendage acicular, short but distinctly exceeding anther apex; style *c.* 2.5x the length of ovary. **Fruits:** pedicels to 4 mm long; calyx tube obconical, shallow, to 0.6 cm deep, 1 cm diameter; *calyx lobes broadly spatulate*, *obtuse*, *to 4 × 2 cm*, tapering to *c.* 8 mm wide above the cup. **Nuts** depressed ovoid, apiculate, to 1.6 × 1.5 cm.

Vernacular name. Sabah—*kapur gumpait* (preferred name).

Distribution. Endemic in Borneo; recorded from Kinabatangan, Sandakan, Tawau, and Tenom districts in Sabah (e.g., *FMS 44430*, *SAN 18732*, *SAN 97485*, and *SAN A 2587*) and from the extreme NE of Kalimantan (e.g., *bb. 17944* and *bb. 18159*).

Ecology. Once locally abundant trees on well-drained but moist clay soils on low hills, at altitudes to 250 m, never far from streams and often on their banks. Vulnerable owing to forest conversion.

5. **Dryobalanops lanceolata** Burck

(Latin, *lanceolatus* = shaped like the head of a spear; the leaf blade)

Ann. Jard. Bot. Buitenz. 6 (1887) 244; Merrill *op. cit.* 401; Slooten *op. cit.* (1932) 28; Keith *op. cit.* 37; Masamune *op. cit.* 489; Wyatt-Smith *op. cit.* 152; Browne *op. cit.* 116; Ashton *op. cit.* (1964) 52, *op. cit.* (1968) 22, *op. cit.* (1982) 374; Meijer & Wood *op. cit.* 285; Burgess *op. cit.* 118; Anderson *op. cit.* (1980) 70; PROSEA *op. cit.* 191; Coode *et al.* (eds.) *op. cit.* 70; Newman *et al. op. cit.* 135. **Type:** *Cult. in Hort. Bog. Sub VIIID 58* (from Beccari via Martin), Borneo, Sarawak, Bintulu district, Ulu Kemena (holotype BO). **Synonym:** *Dryobalanops kayanensis* Becc., *op. cit.* 551.

Tall emergent tree, to 80 m tall, to 2.5 m diameter; bole tall, columnar; crown immense, like a rising thunder cloud; buttresses concave. **Bark** dark leaden green, thinly irregularly flaking. *Leaf buds and stipules fugaceous puberulent*; *parts otherwise glabrous.* **Twigs** *c.* 1.5 mm diameter apically, slender, smooth, pale lenticellate. **Leaves** thinly coriaceous, *glabrous*, drying reddish brown; *blade narrowly lanceolate*, *7–10 × 2–3.5 cm*, base cuneate, *margin revolute at base only*, apex with slender acumen to 1 cm long; *lateral veins subequal*, *unraised below*; petiole *c.* 1 cm long, slender. **Inflorescences** terminal or axillary, simple or singly branched; axis ribbed, to 6 cm long. **Flowers:** buds spindle-shaped, to 12 × 5 mm, obtuse; sepals subequal, lanceolate, obtuse; petals lanceolate, acute, glabrescent; stamens subequal, shorter than the style, anthers linear, connectival appendage hardly exceeding anther apex; style *c.* 3x the length of ovary, glabrous. **Fruits:** calyx impressed at pedicel, *the base united into a shallow cup with waisted rim*, *to 2 cm diameter*, *to 0.5 cm deep*, with a hollow tubercle at the base of each lobe; *calyx lobes spatulate*, *obtuse*, *to 9 × 2 cm*, tapering to 3–5 mm wide at base. **Nuts** ovoid to globose, subacute, to 2 cm long and broad.

Vernacular names. Sabah and Sarawak—*kapur paji* (preferred name). Sarawak—*paji* (Iban), *sesuan* (Murut).

Distribution. Endemic in Borneo. Common and widespread in Sabah, particularly in the eastern parts and recorded from Kudat, Lahad Datu, Papar, Sandakan, Sipitang, Tawau, and Tenom districts (e.g., *SAN 15189*, *SAN 17844*, *SAN 18004*, *SAN 27281*, and *SAN 83425*) and in Sarawak from Belaga, Bintulu, Kapit, Lawas, Limbang, Marudi, Miri, Sibu, Sri Aman, and Tatau districts (e.g., *S 1286*, *S 1428*, *S 15592*, *S 22410*, and *S 32386*). Also occurring in Brunei (e.g., *BRUN 311*, *FMS 34562* and *FMS 39604*), and E and SE Kalimantan (e.g., *bb. 22866*, *bb. 29394*, *Kostermans 5406*, and *Kostermans 6209*).

Ecology. In mixed dipterocarp forest on clay-rich soils, mostly on lower slopes but occasionally to 700 m altitude; most abundant, becoming the dominant emergent on deep moist but well-aerated soils on calcareous shale and basic igneous rocks, therefore threatened outside strictly managed parks. The saplings are shade tolerant, surviving many years and expanding extensive horizontal to slightly pendent plagiotropic branches with only slight extension of the leader shoots; but once a gap is formed young *paji* grow in

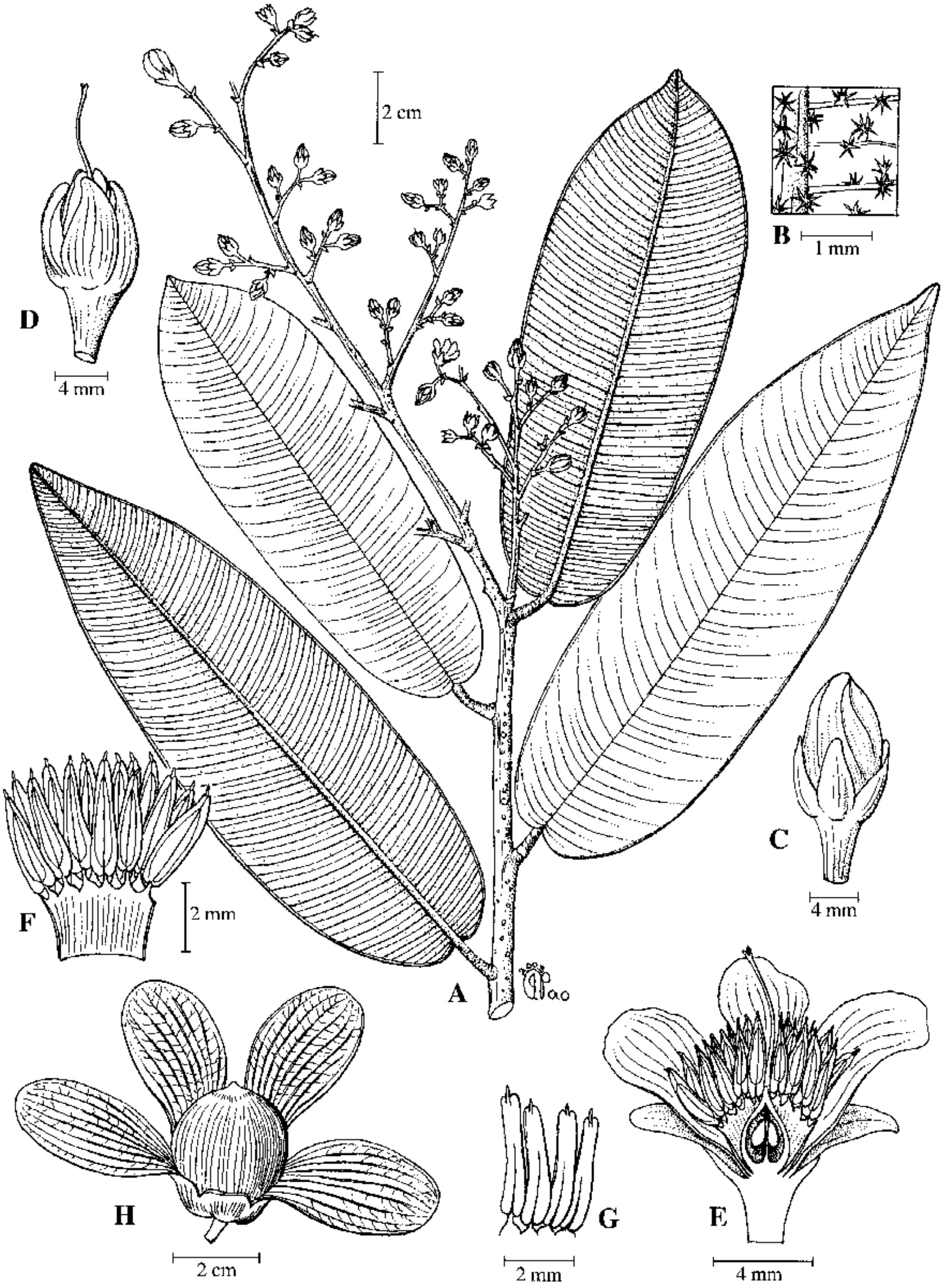

Fig. 11. *Dryobalanops keithii.* A, flowering leafy twig; B, detail of indumentum on lower leaf surface; C, flower bud; D, post-anthesis flower; E, longitudinal section of open flower; F, adaxial view of stamens; G, abaxial view of stamens; H, ripe fruit with one calyx lobe removed. (A–D from *SAN 18732*, E–G from *FMS 55279*, H from *SAN 123771*.)

height at comparable rates to the fastest pioneers. Common in Sepilok FR and Danum Valley Conservation Area, Sabah and locally so in Lambir and Mulu NPs, Sarawak; vulnerable elsewhere owing to land conversion.

6. **Dryobalanops oblongifolia** Dyer Fig. 12, Plate 3D.

(Latin, *oblongus* = rather long, *folium* = leaf; the leaf shape)

J. Bot. 12 (1874) 100; Foxworthy *op. cit.* 118; Slooten *op. cit.* (1932) 22; Symington *op. cit.* (1943) 196; Wyatt-Smith *op. cit.* 153, *p.p.*; Browne *op. cit.* 116; Ashton *op. cit.* (1968) 23, Gard. Bull. Sing. 31 (1978) 25, *op. cit.* (1982) 373. **Type:** *Beccari PB 2533*, Borneo, Sarawak, Matang (holotype K).

Distribution. Sumatra, Peninsular Malaysia and Borneo.

Notes. Two subspecies are recognised, *viz*. subsp. *oblongifolia* and subsp. *occidentalis* P.S.Ashton, with the former occurring in Borneo and the latter in Sumatra and Peninsular Malaysia.

subsp. **oblongifolia**

Beccari, Nelle For. Born. (1902) 550; Merrill *op. cit.* 401; Masamune *op. cit.* 489; Browne *op. cit.* 116; Ashton *op. cit.* (1968) 23, *op. cit.* (1978) 26, *op. cit.* (1982) 373; Anderson *op. cit.* (1980) 114; PROSEA *op. cit.* 192; Newman *et al. op. cit.* 136. **Synonyms:** *Baillonodendron malayanum* F.Heim, *op. cit.* (1890) 867; *Dryobalanops abnormis* Slooten *op. cit.* (1940) 449.

Emergent tree, to 60 m tall, to 2 m diameter. **Bark** dark yellowish brown, flaky, occasionally becoming shaggy. *Inflorescence densely evenly rufous-pubescent*; *young shoots fugaceous pale fulvous-pubescent*; *parts otherwise glabrescent*. **Twigs** *c.* 2 mm diameter apically, smooth, shiny. **Leaves** thinly coriaceous, frequently undulate, *glabrous*, drying rust-brown, paler above than below; *blade oblong*, 6–20 × 4.5–5(–6.5) cm, base broadly cuneate to obtuse, *margin not revolute at base*, apex cuspidate with acumen to 1.5 cm long; *lateral veins subequal*, *distinct but only slightly elevated below*, with visible branching intermediate veins; petiole 0.5–1.2 cm long. **Inflorescences** terminal or axillary, singly branched, to 14 cm long. **Flowers:** buds ovoid, to 8 × 5 mm, glabrous; sepals ovate, acute; petals oblong; stamens *c.* 40, unequal, reaching to below the style apex, filaments *c.* half the length of anthers, broadly lorate, anthers linear, connectival appendage more or less erect, exceeding anther apex; style 2–3x as long as ovary, glabrous. **Fruits** subsessile; *calyx lobes shorter than the nut*, *incrassate*, *deltoid*, *acute*, *often reflexed*, *to 0.5 × 0.7 cm*, bordering a massive incrassate basal cup to 1.5 cm deep and diameter. **Nuts** ellipsoid to obovoid, to 3.5 × 2.7 cm, more or less mucronate, prominently lenticellate.

Vernacular names. Sarawak—*kapur kelansau* (preferred name), *kelansau* (Iban).

Distribution. Endemic in Borneo. Recorded in Sarawak from Kapit, Kuching, Lundu, Mukah, and Serian districts (e.g., *S 4432*, *S 18628*, *S 19652*, and *S 27008*). Also occurring in W, C and E Kalimantan (e.g., *bb. 16952*, *bb. 30212*, *bb. 31221*, and *Wilkie 94309*).

Ecology. Locally common in mixed dipterocarp forest, on sandy clay soils, on undulating land, in valleys and on slopes, at altitudes to 600 m; frequently as small groups of mature individuals but not seen to dominate the canopy over large areas. Vulnerable, though occurring in Kubah NP.

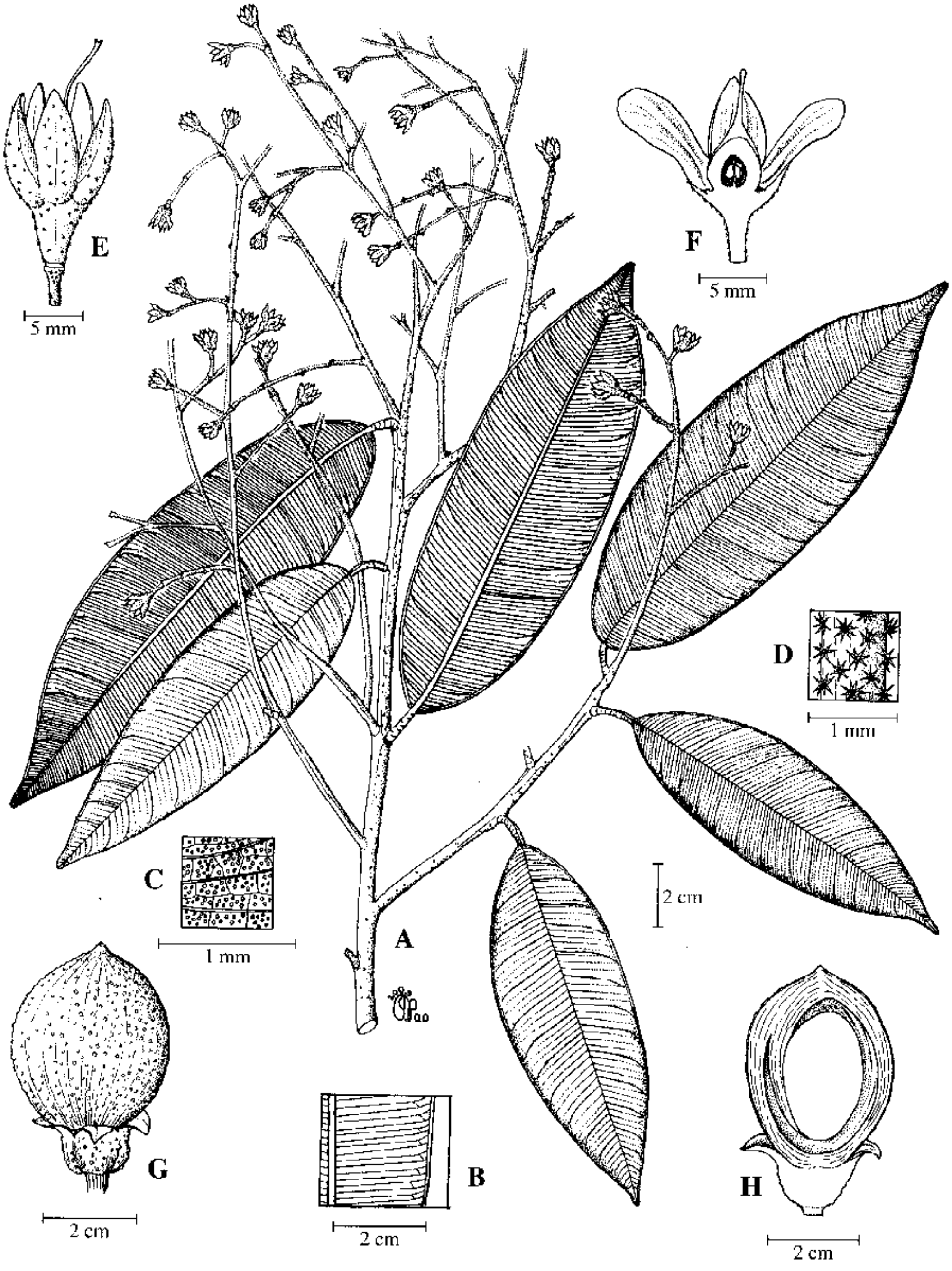

Fig. 12. *Dryobalanops oblongifolia* subsp. *oblongifolia.* A, flowering leafy twig; B, detail of venation on lower leaf surface; C, detail of indumentum on lower leaf surface; D, detail of indumentum on inflorescence and flowers; E, post-anthesis flower; F, longitudinal section of post-anthesis flower; G, mature fruit; H, longitudinal section of mature fruit. (A–F from *S 23993*, G–H from *S 41496*.)

7. **Dryobalanops rappa** Becc.
(from an Iban word—*kerapa* = a shallow swamp; the habitat)

Nelle For. Born. (1902) 572; Merrill *op. cit.* 401; Slooten *op. cit.* (1932) 41; Keith *op. cit.* 37; Masamune *op. cit.* 489; Browne *op. cit.* 116; Wyatt-Smith *op. cit.* 155; Anderson, Gard. Bull. Sing. 20 (1963) 157, *op. cit.* (1980) 114; Ashton *op. cit.* (1963) 242, *op. cit.* (1964) 53, *op. cit.* (1968) 23, *op. cit.* (1978) 25, *op. cit.* (1982) 377; Meijer & Wood *op. cit.* 289; Burgess *op. cit.* 118; PROSEA *op. cit.* 192; Coode *et al.* (eds.) *op. cit.* 70; Newman *et al. op. cit.* 137. **Type:** *Beccari s.n.*, Borneo, Sarawak, Kuching (holotype FI).

Emergent tree, to 55 m tall, to 1.5 m diameter. **Bark** becoming rufous-brown, shaggily flaky. *Exposed fleshy parts, leaf blade above, flower and fruit, and sapling excepted, densely powdery more or less persistently rufous-tomentose.* **Twigs** *c.* 1.5 mm diameter apically, smooth but for minute warty lenticels. **Leaves** coriaceous, drying mauve-brown above, *rufous to greyish tomentose below*; *blade* ovate-lanceolate, *6–11 × 2.5–4 cm*, base obtuse, *margin only partially revolute*, apex with slender acumen to 1 cm long; *lateral veins subequal, unraised below*; petiole 0.6–1 cm long, stout. **Inflorescences** terminal or axillary, doubly branched, to 8 cm long. **Flowers:** buds ellipsoid, to 10 × 5 mm, acute; sepals narrowly deltoid, obtuse; petals cream, lanceolate; stamens reaching to below style apex, filaments *c.* 2/3x the length of anthers; anthers narrowly oblong, connectival appendage erect, extending somewhat above anther apex; *style c. 2x as long as ovary*, glabrous. **Fruits:** *calyx with shallow basal cup to 0.8 cm diameter, to 0.3 cm deep*; *calyx lobes thinly coriaceous, linear-spatulate, to 5 × 0.6 cm*, subacute, tapering to 3.5 mm wide at base. **Nuts** *ovoid, to 1 × 0.6 cm, mucronate.*

Vernacular name. Sabah and Sarawak—*kapur paya* (preferred name).

Distribution. Endemic in Borneo. Recorded in Sabah from Beaufort, Papar and Sipitang districts (e.g., *FMS 41106*, *FMS 49021*, *SAN 27991*, *SAN 78005*, and *SAN A 1704*), and in Sarawak from Bintulu, Kuching, Lawas, Limbang, Lundu, Marudi, Miri, Sematan and Sibu districts (e.g., *Haviland 2226*, *S 1270*, *S 1504*, *S 4850*, and *S 11242*). Also occurring in Brunei (e.g., *BRUN 5105*, *BRUN 5106*, *FMS 28696*, *FMS 30640*, and *Wong WKM 917*).

Ecology. In coastal mixed peat swamp forest, particularly over sands behind the sea beach but also on clay, and in lower montane *kerangas*, at altitudes to 900 m. Vulnerable, though occurring in Mulu NP

5. **HOPEA** Roxb., *nom. cons.*
(John Hope, 1725–1786, the first Regius Keeper of the Royal Botanic Garden, Edinburgh)

luis (Iban), *selangan* (Malay)

Pl. Corom. 3 (1811) 7; King, J. As. Soc. Beng. 62, 2 (1893) 125; Ridley, FMP 1 (1922) 234; Foxworthy, Malay. For. Rec. 10 (1932) 113; Symington, Malay. For. Rec. 16 (1943) 108; Browne, FTSB (1955) 116; Ashton, Gard. Bull. Sing. 20 (1963) 254, MDB (1964) 89, MDBS (1968) 37, Gard. Bull. Sing. 31 (1978) 28, FM 1, 9 (1982) 391; Meijer & Wood, Sabah For. Rec. 5 (1964) 203; Backer & Bakhuizen *f.*, FJ 1 (1964) 330; Burgess, TBS (1965) 128; Anderson, CLTS (1980) 114; PROSEA, 5, 1 (1993) 238 & 255; Kessler & Sidiyasa, TBSA-EK (1994) 96; Coode *et al.* (eds.), CLBD (1996) 71; Newman *et al.*, MDFB-MHHW (1998) 139. **Synonyms:** *Neisandra* Rafin., Sylv. Tell. (1838) 163; *Petalandra* Hassk., Cat. Hort. Bog. (1858) 104; *Balanocarpus* Bedd., For. Man. Bot. (1873) 236 *bis*;

Hancea Pierre, For. Fl. Coch. 4 (1891) *sub t.* 244; *Pierrea auct. non* Hance: Heim, Bull. Mens. Soc. Linn. Paris 2 (1891) 958; *Dioticarpus* Dunn, Bull. Misc. Inform. Kew (1920) 337.

Main canopy and subcanopy, occasionally low emergent trees, *with narrow buttresses*, *often flying buttresses*, *sometimes stilt roots*. **Bark** *variously smooth*, *chocolate-brown mottled*, *or flaky or fissured*; *inner bark uniform pale yellowish brown*, *finely fibrous*. **Sapwood** variously moderately soft to very hard, cream-white to straw yellow; heartwood pale to dark chocolate-brown. **Twigs** generally slender, terete, smooth, brown, *with short inconspicuous stipule scars*. Leaf buds generally minute. **Stipules** *linear*, *early caducous except in juveniles*. **Leaves** small or medium-sized, occasionally large; *venation pinnate*, *without intramarginal veins*, either 'hopea-type', *i.e. with all lateral veins more or less parallel and reaching the leaf margins*, *without intermediates*, *and with scalariform intercostal venation* (in sect. *Hopea*, e.g., *H. nervosa* and *H. rudiformis*), or 'dryobalanoid', *i.e. with many fine but arched and unequal lateral veins and obscurely reticulate intercostal venation* (in sect. *Dryobalanoides* subsect. *Dryobalanoides*), or 'subdryobalanoid', *i.e. intermediate between these* (in sect. *Dryobalanoides* subsect. *Sphaerocarpae*); *petiole rarely geniculate.* **Inflorescences** paniculate, slender, terminal or axillary or ramiflorous when frequently fascicled. **Flowers** *secund*; *buds small*, ovoid or globose; *2 outer sepals ovate*, *acute or obtuse*, *thickened*, *3 inner ones suborbicular*, *thin at margins*, *frequently mucronate*; petals oblong, strongly contorted, connate at base forming a basal cup with rotate twisted lobes, falling in a rosette; stamens 10, 15 or to 38 (*H. plagata*), attached to the base of the petals and falling with them, filaments broad at base, tapering and filiform distally, anthers broadly ellipsoid to globose, more or less tapering apically, connectival appendage usually at least twice the length of anther, very slender, glabrous or minutely tuberculate; ovary glabrous or pubescent, ovoid and without stylopodium or with stylopodium and variously pyriform, cylindrical or hourglass-shaped, style columnar, long (if without stylopodium) or more or less short (if with stylopodium), stigma obscure. **Fruits** *relatively small*, usually glabrous; *2 outer calyx lobes generally spatulate and enlarged*, *the 3 inner ones remaining as broad as long*, *embracing the base of the nut and generally shorter than it at maturity*; *frequently all 5 sepals short*; *all sepals expanded and thickened around the base of the nut and appressed to it*. **Nuts** ovoid, generally glabrous, *apiculate with the distinct floral stylopodium*, *when present*, *persisting*; pericarp splitting at germination irregularly or occasionally into 3 valves.

Distribution. About 104 species, distributed from Sri Lanka and S India to S China, and southeastward throughout Malesia (the Lesser Sunda Is. excepted), to New Guinea; 43 species occur in Sabah and Sarawak.

Ecology. Main and subcanopy trees of lowland forests at altitudes below 800 m, rarely to 1600 m. In mixed and upper dipterocarp, *kerangas* and mixed peat swamp forests, and a few species on limestone karst; several are confined to river banks. Most, especially those with short fruit sepals, occur in tightly clustered groups with their juveniles, sometimes extending to form semi-gregarious populations.

Notes. *Hopea* is not difficult for the field worker to recognise on account of the characters italicised in the description given above. From the related genus *Shorea* (see there) most *Hopea* differ in being of the main canopy or subcanopy, with stilt roots and flying buttresses (virtually absent in *Shorea*), more slender twigs, smaller flowers and of course the two-winged usually smaller and generally glabrous fruit. However, the great variability in ovary, leaf, bark and mature habit make this one of the most diverse dipterocarp genera. Two sections, each with two subsections are recognised according to the characters indicated in the systematic key; but these entities have greater floral diversity than do the sections of *Shorea*, and several species with intermediate characters exist; the boundaries are therefore to an extent arbitrary. Curiously, molecular evidence (Kamiya *et al.*, *Tropics* 7 (1998) 195–207; Dayanandan *et al.*, *Amer. J. Bot.* 86 (1999) 1182–1190) indicates that the genus is indeed monophyletic, but nested between the sections of the vast genus *Shorea* along with *Parashorea* and *Neobalanocarpus* (a monotypic genus of Peninsular Malaysia).

Hopea species generally have smooth, often hoop-marked, or flaky bark; but some dryobalanoid species, *viz. H. beccariana*, *H. cernua*, *H. coriacea*, *H. mengerawan*, and *H. treubii* may have deeply v-section fissured chocolate brown bark in large trees. Curiously, this seems not to be always the case, as populations occur in *H. beccariana* and *H. coriacea*, in which large individuals are present, in which the bark remains at most irregularly cracked.

Key to *Hopea* species

(based on flowering and/or fruiting specimens)

1. Leaf venation hopea-type or subdryobalanoid……………………………………………2
Leaf venation dryobalanoid (sect. **Dryobalanoides** subsect. **Dryobalanoides**)…………4

2. Ovary and stylopodium not or only slightly constricted in between; leaf blade oblong-lanceolate, ovate-lanceolate, lanceolate, ovate to narrowly elliptic or suborbicular……3
Ovary and stylopodium hourglass-shaped, distinctly constricted at base of stylopodium; leaf blade generally narrowly oblong (sect. **Hopea** subsect. **Pierrea**)…………………37

3. Flowers remote on inflorescence; bracts subpersistent (sect. **Dryobalanoides** subsect. **Sphaerocarpae**)………………………………………………………………………………20
Flowers dense on inflorescence; bracts fugaceous (sect. **Hopea** subsect. **Hopea**)……28

4. Ovary without a distinct stylopodium, ovoid with long filiform or columnar style…….5
Ovary with distinct stylopodium, style short……………………………………………15

5. Shorter fruit calyx lobes concealing ripe nut……………………………………………6
Shorter fruit calyx lobes not or hardly concealing ripe nut (ripe nut apex exposed)…....9

6. Leaf margin revolute………………………………………………………………………7
Leaf margin not revolute…………………………………………………………………8

7. Leaf blade to 5 cm wide, elliptic to ovate, thinly coriaceous; stamens 15–18……………
……………………………………………………………………………………**8. H. cernua**
Leaf blade 6–10 cm wide, broadly ovate to suborbicular, thickly coriaceous; stamens at most 15…………………………………………………………………**9. H. coriacea**

8. Fruit pedicel to 7 mm long; calyx lobe base prominently tuberculate……………………...
………………………………………………………………………**19. H. longirostrata**
Fruit pedicel to 2 mm long; calyx lobe base incrassate but not tuberculate……………...
……………………………………………………………………………**15. H. fluvialis**

9. Leaf lateral veins at least 14 pairs, indistinct below…………………………………..…10
Leaf lateral veins less than 14 pairs, distinct below……………………………………11

10. Leaf base cuneate……………………………………………………**21. H. mengerawan**
Leaf base obtuse………………………………………………………..**23. H. micrantha**

11. Fruit calyx lobes short, subequal; leaf lateral veins at most 6 pairs………………………
……………………………………………………………………….**17. H. kerangasensis**
Fruit calyx lobes unequal, 2 larger ones spatulate; leaf lateral veins at least 8 pairs…..12

12. Nut to 1.5 cm long, cylindrical-oblong……………………………...….**42. H. vesquei**
Nut shorter than 1.1 cm, ovoid……………………………………………………..…13

13. Fruit calyx lobes larger, 2 longer ones tapering to 5 mm above the saccate base, 3 shorter ones shorter than the nut; leaf midrib acute on both surfaces, drying black……...
……………………………………………………………**11. H. dryobalanoides**
Fruit calyx lobes smaller, 2 longer ones tapering to 1.5–3 mm above the saccate base, 3 shorter ones conceiling the nut; leaf midrib terete, not drying black…………….…14

14. Leaf blade lanceolate; petiole at most 1 cm long; twig apex persistently puberulent……
…………………………………………………………………………..**14. H. ferruginea**
Leaf blade ovate; petiole at least 1.2 cm long; twig glabrescent…………**18. H. latifolia**

15. Leaf midrib obscure, sunken above……………………………………**16. H. griffithii**
Leaf midrib evident, more or less raised above………………………………………...16

16. Stamens *c.* 10; leaf blade broadly elliptic-obovate………………………..…**40. H. treubii**
Stamens *c.* 15; leaf blade ovate to lanceolate……………………………………….…17

17. Ovary and stylopodium pyriform or hourglass-shaped………………………………..…18
Ovary and stylopodium cylindrical…………………………………………………..…19

18. Leaf blade broadly ovate; petiole 1.2–1.7 cm long…………………..…**4. H. beccariana**
Leaf blade narrowly ovate-lanceolate; petiole at most 1 cm long…………..…**12. H. dyeri**

19. Margin of leaf blade base prominently revolute……………………..…**2. H. altocollina**
Margin of leaf blade base not revolute……………………………..…**30. H. pedicellata**

20. Leaf venation hopea-type…………………………………………………………….…21
Leaf venation subdryobalanoid…………………………………………………………23

21. Fruit calyx lobes short, subequal…………………………………...…**1. H. aequalis**
Fruit calyx lobes unequal, 2 larger ones spatulate…………………………………...…22

22. Leaf lateral veins at most 13 pairs; blade dull below……………..….**34. H. rudiformis**
Leaf lateral veins 13–15 pairs; blade not dull, drying dark chocolate-brown below……..
……………………………………………………………………………**25. H. nervosa**

23. Fruit calyx lobes unequal, 2 larger ones spatulate……………………....**24. H. montana**
Fruit calyx short, subequal……………………………………………………………24

24. Leaf blade oblong-lanceolate or ovate-lanceolate, at least 7 cm long…………………25
Leaf blade ovate, at most 6 cm long……………………………………………….…27

25. Petiole at least 0.7 cm long; leaf blade coriaceous, drying honey-brown………………...
……………………………………………………………………..**22. H. mesuoides**
Petiole at most 0.6 cm long; leaf blade chartaceous, drying grey or tawny brown……26

26. Leaf blade undulate or more or less flat on drying, with obtuse base…………………….
……………………………………………………………………..**38. H. sphaerocarpa**
Leaf blade wrinkled on drying, base more or less cuneate…………..…**35. H. rugifolia**

27. Stamens *c.* 10; leaf blade at most 2.5 cm long……………………..…**41. H. vaccinifolia**
Stamens *c.* 15; leaf blade at least 2.5 cm long……………………...…**5. H. bracteata**

28. Stamens *c.* 10……………………………………………………………………29
Stamens 15 or more..…………………………………………………………………30

29. Leaf lateral veins at most 8 pairs; domatia obscure, glabrous, or absent…………………
……………………………………………………………………..**10. H. depressinerva**
Leaf lateral veins at least 10 pairs; domatia evident, pubescent………..…**36. H. sangal**

30. Style as long as ovary………………………………………………….…**7. H. centipeda**
Style very short (shorter than ovary)……………………………………………...…31

31. Stamens at least 32……………………………………………………**32. H. plagata**
Stamens at most 15…………………………………………………………………..…32

32. Leaf base obtuse; domatia pore-like, prominently swollen……………….**26. H. nutans**
Leaf base cuneate; domatia not prominently swollen…………………………………33

33. Leaf lateral veins at most 5 pairs…………………………………….**31. H. pentanervia**
Leaf lateral veins at least 6 pairs…………………………………………………..…34

34. Leaf base distinctly unequal……………………………………….…**3. H. andersonii**
Leaf base equal to subequal……………………………………………………………35

35. Inflorescence glabrous…………………………………………….…**20. H. megacarpa**
Inflorescence densely persistently buff-pubescent……………………………………36

36. Ovary and stylopodium ovoid…………………………………………..…**28. H. ovoidea**
Ovary and stylopodium cylindrical, truncate……………………….…**37. H. semicuneata**

37. Leaf blade broadly ovate, base equal; inflorescence solitary…..….**43. H. wyatt-smithii**
Leaf blade narrowly oblong, elliptic to lanceolate, base unequal, obtuse to subcordate at least on one side; inflorescence usually more than 1 in each leaf axil……………....38

38. Fruit calyx lobes short, subequal; leaf blade pale, often silvery below..………………… ……………………………………………………………………..**29. H. pachycarpa**
Fruit calyx lobes unequal, 2 larger ones spatulate; leaf blade not silvery below..……...39

39. Leaf blade prominently bullate between the intercostal venation…..…**6. H. bullatifolia**
Leaf blade not bullate or only slightly so..……………………………….…………40

40. Base of fruit calyx lobes auriculate…………………………….....….**33. H. pterygota**
Base of fruit calyx lobes not auriculate………………………………….…………..…41

41. Leaf lateral veins more prominent above than below; blade thickly coriaceous, drying pale pinkish brown below..………….………………….…………..…**27. H. obscurinerva**
Leaf lateral veins more prominent below than above; blade thinly coriaceous, drying chocolate- or greenish-brown below…………………………………….………..…42

42. Leaf blade (mature trees) smaller, 10–27 × 3–5.5 cm, drying chocolate-brown; lateral veins 12–21 pairs…………………….………………….…………..….**39. H. tenuinervula**
Leaf blade larger, 27–46 × 8–15 cm, drying greenish brown; lateral veins 16–30 pairs… ……………………………….…………………………………**13. H. enicosanthoides**

Key to *Hopea* species

(based on field characters)

1. Leaf venation dryobalanoid or subdryobalanoid……………………….……………..…2
Leaf venation hopea-type……………………………………………….…………..…29

2. Bark fissured or densely flaky; stilt roots few or none…..…………….…………..…3
Bark smooth or cracked to patchily flaky only; stilt roots present at least on young trees……………………………………………………………………………….9

3. Leaf blade at least 6 cm wide, thickly coriaceous……………..…**9. H. coriacea** (in part)
Leaf blade at most 5.5 cm wide, not thickly coriaceous…………….…………….…..…4

4. Bark surface dark or chocolate brown, fissured………………….……………......…5
Bark surface tawny brown, powdery flaky or hoop-marked or patchily cracked or v-section fissured……….……………………….………………………………...…7

5. Leaf lateral veins raised below, drying blackish………………..…**8. H. cernua** (in part)
Leaf lateral veins unraised below, not drying blackish……………….…………….…6

6. Petiole at most 1.1 cm long, stout……………….……………..…**21. H. mengerawan**
Petiole at least 1.2 cm long, slender……………………….……………**4. H. beccariana**

7. Leaf blade broadly elliptic-obovate, apex shortly acuminate…………..…**40. H. treubii**
Leaf blade narrowly ovate to lanceolate, apex not acuminate………………………......8

8. Leaf lateral veins prominent below; leaf margin revolute at base.……..**2. H. altocollina**
Leaf lateral veins obscure below; leaf margin not revolute at base………….…………
……………………….……………….……………….…………**30. H. pedicellata** (in part)

9. Midrib obscure, sunken above……………….………………………………………10
Midrib evident, more or less raised above…………………………………….…..…17

10. Leaf venation dryobalanoid; intercostal venation obscure below……….…………..…11
Leaf venation subdryobalanoid; intercostal venation evident below (except *H. montana*)
…………………………….……………………………….………………………….12

11. Leaf lateral veins at least 9 pairs, without domatia…………………..…**16. H. griffithii**
Leaf lateral veins at most 6 pairs, with pubescent axillary domatia……………………...
………..…………………………………………………………**17. H. kerangasensis**

12. Leaf larger, 8–14 cm long……………….…………….……………..…**22. H. mesuoides**
Leaf blade smaller, 1–10 cm long……………………………………….…………..…13

13. Intercostal venation obscure below……………………….…………**24. H. montana**
Intercostal venation distinct below…………………………………….………………14

14. Leaf blade elliptic to narrowly or broadly ovate……………….…………………..……15
Leaf blade broadly lanceolate to oblong-lanceolate…….…………….……………...…16

15. Leaf blade 2.5–6 × 0.7–2 cm; petiole 0.2–0.4 cm long. In forest on clay soils…………..
………………………………………………………………………..**5. H. bracteata**
Leaf blade 1–2.5 × 0.4–1.2 cm; petiole to 0.2 cm long. In forest on white sand podsols…………….……………………………….………..…**41. H. vaccinifolia**

16. Leaf blade obtuse at base, not wrinkled on drying……………..….**38. H. sphaerocarpa**
Leaf blade cuneate at base, wrinkled on drying……………….……..….**35. H. rugifolia**

17. Leaf venation subdryobalanoid; inner bark plum-red….…**43. H. wyatt-smithii** (in part)
Leaf venation dryobalanoid; inner bark pale brown or pink…………………………18

18. Leaf blade suborbicular; main lateral veins at most 4 pairs……..**9. H. coriacea** (in part)
Leaf blade ovate, elliptic, lanceolate or oblong-lanceolate; main lateral veins at least 5 pairs………………………………………………………………………………19

19. Midrib sharp below, tending to dry black…………………………………….…20
Midrib terete below, not drying black………………………………...……22

20. Young twigs glabrous; inner bark pale brown……………….…**19. H. longirostrata**
Young twigs pubescent; inner bark pinkish brown…………………………….…21

21. Leaf blade coriaceous; main lateral veins *c.* 15 pairs, not drying black………………………………**30. H. pedicellata** (in part)
Leaf blade chartaceous; main lateral veins at most 12 pairs, drying black………………………………**11. H. dryobalanoides** (in part)

22. Leaf base equal to subequal………………………………23
Leaf base unequal, blade twisted slightly to one side………………………………25

23. Leaf base obtuse………………………………**23. H. micrantha**
Leaf base cuneate………………………………24

24. Leaf lateral veins slightly raised below, drying paler than the blade………………………………**11. H. dryobalanoides** (in part)
Leaf lateral veins indistinct, hardly raised below, drying not paler than the blade………………………………**18. H. latifolia**

25. Basal pair of lateral veins continuing up leaf margin for one third of its length………………………………**15. H. fluvialis**
Basal pair of lateral veins short………………………………26

26. Leaf lateral veins distinctly raised below………………………………**8. H. cernua** (in part)
Leaf lateral veins somewhat or not raised below………………………………27

27. Leaf blade broadly ovate, thickly coriaceous, base subobtuse; bark surface with short shallow surface fissures………………………………**42. H. vesquei**
Leaf blade narrowly ovate-lanceolate, thinly coriaceous to coriaceous, base cuneate; bark smooth becoming thinly flaky………………………………28

28. Leaf lateral veins at most 12 pairs………………………………**12. H. dyeri**
Leaf lateral veins *c.* 14 pairs………………………………**14. H. ferruginea**

29. Bark scaly, vertically cracked or flaky………………………………30
Bark smooth………………………………39

30. Leaf lateral veins at most 5 pairs………………………………**31. H. pentanervia**
Leaf lateral veins at least 6 pairs………………………………31

31. Leaf base markedly unequal………………………………32
Leaf base subequal to equal………………………………35

32. Leaf blade more than 3x as long as wide; lateral veins 12–21 pairs………………………………**39. H. tenuinervula**
Leaf blade less than 2½x as long as wide; lateral veins 7–12 pairs………………………………33

33. Leaf lateral veins with pubescent axillary domatia………………………………**3. H. andersonii**
Leaf lateral veins without or with a few glabrous domatia………………………………34

34. Leaf lateral veins 8–11(–12) pairs, domatia, if present, pore-like; leaf bud glabrous………………………………**32. H. plagata**

Leaf lateral veins 7–8(–10) pairs, domatia canaliculate; leaf bud puberulent………………………………………………………………………….**28. H. ovoidea** (in part)

35. Leaf lateral veins 10–12 pairs; bark surface dark brown with conspicuous white dammar coxcombs…..…**36. H. sangal**
Leaf lateral veins less than 10 pairs; bark surface brown, dammar exudations not conspicuous……………………………………………………………………….…….36

36. Leaf blade broadly ovate, thickly coriaceous, greyish lepidote below…....**26. H. nutans**
Leaf blade lanceolate, narrowly elliptic or narrowly ovate-elliptic, chartaceous to thinly coriaceous, undulate, not pale lepidote below………………………………………37

37. Leaf lateral veins sharply raised below, domatia obscure or absent……………………..……………………………………………………………….**10. H. depressinerva**
Leaf lateral veins not sharply raised below, with prominent axillary domatia………...38

38. Domatia canaliculate…………………………………….…**28. H. ovoidea** (in part)
Domatia pore-like…………………………………………………**37. H. semicuneata**

39. Leaf base equal……………………………………………………………………..…40
Leaf base markedly unequal or subequal……………………………………………....44

40. Leaf lateral veins at most 8 pairs………………………………………………………41
Leaf lateral veins at least 11 pairs…………………………………………………..…42

41. Leaf blade broadly ovate, midrib prominent above; inner bark bright plum-red………...…………………………………………………………..**43. H. wyatt-smithii** (in part)
Leaf blade narrowly ovate-lanceolate, midrib flat above; inner bark yellowish brown….…………………………………………………………………….**20. H. megacarpa**

42. Leaf lateral veins at least 16 pairs…………………………………….…**1. H. aequalis**
Leaf lateral veins at most 15 pairs……………………………………………………..43

43. Leaf blade dull below; lateral veins 11–13 pairs……………………....**34. H. rudiformis**
Leaf blade drying chocolate-brown below, not dull; lateral veins 13–15 pairs……….….……………………………………………………………………**25. H. nervosa**

44. Leaf lateral veins at most 9 pairs, midrib sunken above; stilt-rooted river bank tree…….…………………………………………………………………………**7. H. centipeda**
Leaf lateral veins at least 10 pairs, midrib raised above; not as above...........................45

45. Leaf lateral veins and midrib more prominent above than below.....**27. H. obscurinerva**
Leaf lateral veins and midrib more prominent below than above……………….….46

46. Leaf blade distinctly bullate between intercostal veins…………..…..**6. H. bullatifolia**
Leaf blade flat to somewhat convex between veins above…………………………..…47

47. Leaf blade larger, 27–46 × 8–15 cm, base cordate…………..…**13. H. enicosanthoides**
Leaf blade smaller, 12–28 × 4–9 cm, base not cordate……………………………..…48

48. Leaf blade drying reddish brown, lateral veins sunken above; young parts glabrescent… ……………………………………………………………………..**33. H. pterygota**
Leaf blade drying greyish green, lateral veins flat above; young parts pubescent, white pruinose or silvery lepidote……………………………………….…**29. H. pachycarpa**

1. **Hopea aequalis** P.S.Ashton

(Latin *aequalis* = equal; the fruit calyx lobes)

Gard. Bull. Sing. 22 (1967) 271, *op. cit.* (1968) 46, *op. cit.* (1982) 409; Anderson *op. cit.* (1980) 114. **Type:** *Ilias S 15881*, Borneo, Sarawak, Bintulu district, Nyabau FR (holotype K; isotypes KEP, L). **Synonym:** *Hopea* '*sp. nov. aff. H. pachycarpa*' Meijer & Wood *op. cit.* 229.

Subcanopy tree, to 20 m tall, to 20 cm diameter, with narrow buttresses, flying buttresses and stilt roots. **Bark** *smooth*. *Living surfaces glabrous but for the puberulent midrib above.* **Twigs** *c.* 2 mm diameter apically. **Leaves** chartaceous, drying greyish brown above, yellowish brown below; *blade oblong-lanceolate*, 13–25 × 5.5–8 cm, *base equal*, *obtuse*, apex acuminate, acumen to 1 cm long, tapering; midrib shallowly furrowed but evident above, slender and prominent below; *venation hopea-type*; *lateral veins 16–20 pairs*, slender but prominent below; intercostal venation densely scalariform, hardly raised; petiole 1.5–1.8 cm long, *c.* 2 mm diameter. **Inflorescences** to 9 cm long, axillary, unbranched or singly branched; rachis *c.* 1 mm diameter; *flowers remote*; *bracts subpersistent*. **Flowers** unknown. **Fruits:** *calyx lobes subequal*, *ovate*, *subacute*, *saccate*, *to 1.8 × 1.6 cm*. **Nuts** ovoid, to 2.3 × 1.5 cm, acute, frequently resin-coated.

Vernacular name. Sabah—*selangan sama* (preferred name).

Distribution. Endemic in Borneo; uncommon. In Sabah once recorded from Sandakan district (*SAN 38797*) and in Sarawak known from Nyabau FR, Bintulu district (the type) and from Bt. Mersing, Tatau district (e.g., *S 22493*). Also occurring in Brunei (*Cowley 137*).

Ecology. In mixed dipterocarp forest on low hills and near streams, at altitude below 100 m. Critically endangered owing to its disappearing habitat.

2. **Hopea altocollina** P.S.Ashton

(Latin, *altus* = high, *collinus* = concerning hills; inhabitant of hill sites)

Gard. Bull. Sing. 22 (1967) 272, *op. cit.* (1968) 46, *op. cit.* (1982) 409; Anderson *op. cit.* (1980) 115; PROSEA *op. cit.* 244; Newman *et al. op. cit.* 145. **Type:** *Ashton BRUN 1030*, Borneo, Sarawak, Limbang district, Bt. Antu, Ulu Sembayang (holotype K; isotypes KEP, L).

Tall main canopy or low emergent tree, to 50 m tall, to 1.8 m diameter; bole tall; buttresses thin, convex, to 4 m tall; crown evenly hemispherical with many ascending branches. **Bark** *tawny brown*, *shallowly fissured and powdery oblong-flaky*. *Perianth sericeous outside*; *parts otherwise glabrous.* **Twigs** *c.* 2 mm diameter apically. **Leaves** *thinly coriaceous*, drying yellowish brown with dark midrib below; *blade lanceolate*, *7–10 × 3–4.5 cm*, *base obtuse*, *with revolute margin and appearing cuneate*, *apex caudate*, *with tapering acumen to 1 cm long*; *midrib slender*, *slightly raised above and below*; *venation dryobalanoid*; *main lateral veins c. 16 pairs*, *elevated below*; petiole 1–1.3 cm long, slender, somewhat geniculate. **Inflorescences** to 8 cm long, terminal or in axillary pairs, singly branched.

Flowers: petals oblong, cream; *stamens c. 15*, connectival appendage *c.* 2x as long as anther; *ovary and stylopodium cylindrical*, *with punctate obtuse apex and short style.* **Fruits:** pedicels to 2 mm long; calyx lobes unequal, 2 longer lobes spatulate, obtuse, to 4.5 × 0.8 cm, tapering to 3 mm wide above the saccate base, 3 shorter ones suborbicular, obtuse, to 0.4 × 0.4 cm, shorter than the nut. **Nuts** ovoid, to 0.7 × 0.5 cm, apiculate.

Vernacular name. Sarawak—*luis gunung* (preferred name).

Distribution. Endemic in Borneo; recorded in Sabah from Ulu Mendalong, Sipitang district (e.g., *SAN 16736*) and in Sarawak from Bintulu, Kapit, Limbang, Marudi, and Tatau districts (e.g., *S 21267*, *S 22461*, *S 36185*, *S 49026*, and *S 68645*).

Ecology. In upper dipterocarp forest; locally common on clay-rich soils, at 800–1000 m altitude. Vulnerable owing to logging.

3. **Hopea andersonii** P.S.Ashton

(J.A.R. Anderson, former Forest Officer in Sarawak and Brunei)

Gard. Bull. Sing. 22 (1967) 272, *op. cit.* (1968) 46, *op. cit.* (1982) 425; PROSEA *op. cit.* 258. **Type:** *Anderson S 11096*, Borneo, Sarawak, Bau district, Kuching road (holotype K; isotypes KEP, L).

Medium-sized canopy tree, to 40 m tall, to 1.5 m diameter, with even hemispherical crown; buttresses to 4 m tall, prominent, convex, *c.* 4 cm thick. **Bark** fawn-brown or coppery brown, *vertically cracked and oblong flaky or thinly flaky*. **Sapwood** cream; heartwood coffee-brown. *Parts of flower exposed in bud and ovary densely pale greyish puberulent*; *fruit calyx caducously so*; *living surfaces otherwise glabrous.* **Twigs** *c.* 1 mm diameter apically, slender. **Leaves** coriaceous, drying tawny with venation dark reddish brown below or pale greyish brown; *blade lanceolate-falcate to elliptic or narrowly elliptic-lanceolate*, *5–14 × 2–6 cm*, *base distinctly unequal*, *obtuse adaxially*, *cuneate abaxially*, apex acuminate, acumen to 2 cm long, slender, frequently falcate; midrib evident but flat above, prominent below; *venation hopea-type*; *lateral veins 9–12 pairs*, arched, slender, elevated below, *with prominent pored*, *not swollen*, *pubescent*, *axillary domatia*; intercostal venation hardly elevated; petiole 0.5–1 cm long. **Inflorescences** to 12 cm, terminal or in axillary fascicles, singly branched, *branches with to 9 dense secund flowers*; *bracts fugaceous.* **Flowers:** buds ellipsoid, to 3 × 2 mm; petals oblong, cream; *stamens c. 15*, anthers ellipsoid, connectival appendage to 2½x the length of anther; *ovary and stylopodium cylindrical*, *slightly constricted medially*, *style short columnar.* **Fruits:** pedicels to 3 mm long, slender; calyx lobes unequal, 2 longer lobes oblong, obtuse, to 6 × 2 cm, tapering to 3 mm wide above the saccate base, 3 shorter ones to 0.4 × 0.3 cm, shorter than the nut. **Nuts** ovoid, to 0.8 × 0.5 cm, glabrous, retaining the truncate apical stylopodium and mucronate style remnant.

Vernacular names. Sabah—*selangan* (preferred name). Sarawak—*luis somit* (preferred name).

Distribution. Endemic in Borneo.

Notes. Two subspecies, subsp. *andersonii* and subsp. *basalticola*, are recognised in Sabah and Sarawak.

Key to subspecies

Bark becoming fawn-brown, vertically cracked and oblong-flaky. Leaf blade lanceolate-falcate to elliptic, drying tawny with venation dark reddish brown below……………………

subsp. **andersonii**

Endemic in Sarawak and recorded from Bau, Kuching, Marudi, Serian, and Sri Aman districts (e.g., *S 10038*, *S 10353*, *S 16182*, *S 22876*, and *S 32661*). Locally frequent on limestone karst, at altitudes to 400 m. Not vulnerable.

Bark coppery brown, thinly flaky. Leaf blade frequently narrowly elliptic-lanceolate, drying pale greyish brown………………………………………………………………………...

subsp. **basalticola** P.S.Ashton

(Latinised English, *basalt* (a volcanic rock), -*cola* = growing; growing on basalt-derived soil)

Gard. Bull. Sing. 22 (1967) 273, *op. cit.* (1982) 426. **Type:** *Sibat S 25005*, Borneo, Sarawak, Tatau district, Bt. Mersing, Anap (holotype K; isotypes KEP, L).

Endemic in Borneo; recorded in Sabah from Kinabatangan and Tawau districts (e.g., *FMS 35387*, *SAN 23278* and *SAN 28649*), and in C Sarawak from Marudi, Miri and Tatau districts (e.g., *S 13798*, *S 23481* and *S 25040*). Also occurring in E Kalimantan (e.g., *bb. 13232*, *Kostermans 5431* and *Kostermans 6006*). In mixed dipterocarp forest on deep friable clay soils, over base-rich rocks, at altitudes to 400 m. Vulnerable.

4. **Hopea beccariana** Burck Plate 3E.

(Odoardo Beccari, 1843–1920, Italian explorer and botanist)

Ann. Jard. Bot. Buitenz. 6 (1887) 240; Merrill, EB (1921) 401; Masamune, EPB (1942) 489; Symington *op. cit.* (1943) 122; Browne *op. cit.* 120; Ashton *op. cit.* (1964) 95, *op. cit.* (1968) 48, *op. cit.* (1982) 407; Meijer & Wood *op. cit.* 207; Burgess *op. cit.* 128; Anderson *op. cit.* (1980) 115; PROSEA *op. cit.* 244; Coode *et al.* (eds.) *op. cit.* 71; Newman *et al. op. cit.* 145. **Type:** *Beccari PB 1177*, Borneo, Sarawak (holotype BO). **Synonyms:** *Hancea beccariana* (Burck) Pierre *op. cit.* (1891) *t.* 244; *Hopea nicholsonii* F.Heim *op. cit.* (1891) 973; *Hopea intermedia* King *op. cit.* 126, *p.p.*; *Balanocarpus ovalifolius* Ridl., J. Fed. Mal. Str. Mus. 10 (1920) 130, *p.p.*

Canopy or shortly emergent tree, to 45 m tall, to 1.6 m diameter, with diffuse hemispherical crown and short stout buttresses. **Bark** *generally becoming deeply v-section fissured*, *dark chocolate-brown*. **Sapwood** yellowish brown; heartwood chocolate-brown, hard. *Exposed young living parts and ovary apex caducous puberulent*, *more or less waxy glaucescent*; *parts otherwise glabrous*. **Twigs** *c.* 1 mm diameter apically, slender. **Leaves** *thinly coriaceous*, drying pale yellowish brown including venation; *blade broadly ovate*, *5–8 × 2.2–4.5 cm*, base cuneate, frequently subequal, margin flat, apex caudate, acumen to 1.5 cm long; *midrib slender*, *elevated on both surfaces*; *venation dryobalanoid*, *indistinct*, *hardly raised*, *drying not blackish*; main lateral veins *c.* 8 pairs; intercostal venation obscure, reticulate; *petiole 1.2–1.7 cm long*, *slender,* somewhat geniculate. **Inflorescences** to 7 cm long, generally axillary, singly branched, branches with to 5 secund flowers. **Flowers:** buds small, ellipsoid, subsessile; petals linear, cream; *stamens c. 15*, connectival appendage *c.* 2x as long as anther; *ovary and stylopodium hourglass-shaped*, *tapering into short style*. **Fruits:** calyx lobes unequal, 2 longer lobes spatulate, obtuse, to 3.5 × 1 cm, tapering to 2 mm above the saccate base, 3 shorter ones ovate, acute, to 0.7 cm long, shorter than nut. **Nuts** broadly ovoid, to 0.9 × 0.5 cm, with 1 mm short tapering style remnant.

Vernacular names. Sabah—*selangan penak* (preferred name). Sarawak—*cengal pasir* (preferred name).

Distribution. Peninsular Thailand, Peninsular Malaysia and Borneo. In Sabah widespread and recorded from Keningau, Kinabatangan, Kota Kinabalu, Kota Merudu, Kudat, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Semporna, Sipitang, Tawau, and Tenom districts (e.g., *SAN 15483*, *SAN 18545*, *SAN 25334*, *SAN 38703*, *SAN 47353*, and *SAN 100048*) and in Sarawak from Bintulu, Kapit, Kuching, Lawas, Limbang, Lundu, Marudi, Miri, and Serian districts (e.g., *S 12375*, *S 15212*, *S 15786*, *S 25480*, and *S 37808*). Also occurring in Brunei (e.g., *BRUN 540*, *FMS 35452* and *S 5830*).

Ecology. Locally frequent in mixed dipterocarp forest, on dry, usually deep and sandy soils on ridges. Especially in the coastal hills but occasionally at altitudes to 1200 m. Occurring in Lambir NP; vulnerable owing to land conversion and logging.

Notes. The leaves closely resemble those of *H. latifolia* which however retains smooth bark. They are distinguished when dry from those of *H. dryobalanoides* by their sandy buff-brown colour and pale lateral veins and midrib below.

5. **Hopea bracteata** Burck

(Latin, *bractea* = a thin metal plate; the subpersistent bracts)

Ann. Jard. Bot. Buitenz. 6 (1887) 239; Ashton *op. cit.* (1964) 97, *op. cit.* (1968) 48, *op. cit.* (1978) 31, *op. cit.* (1982) 414; Meijer & Wood *op. cit.* 229; Anderson *op. cit.* (1980) 115; PROSEA *op. cit.* 245; Coode *et al.* (eds.) *op. cit.* 71. **Type:** *Teysmann HB 8265*, Borneo, W Kalimantan (holotype BO). **Synonyms:** *Balanocarpus curtisii* King *op. cit.* 158; *B. bracteatus* (Burck) Merr. *op. cit.* (1921) 407; *Hopea minima* Symington, Gard. Bull. S. S. 10 (1939) 337.

Subcanopy, occasionally low canopy tree, to 35 m tall, to 60 cm diameter, *with* flying buttresses and *stilt roots*; crown frequently persistently monopodial, with somewhat pendent branches in juveniles. **Bark** *smooth*. *Young twig*, *buds and petiole shortly persistently greyish puberulent*; *floral sepals fimbriate*; *parts otherwise glabrous*. **Twigs** *c.* 0.7 mm diameter apically, very slender. **Leaves** chartaceous, drying dull greyish green; *blade elliptic to narrowly ovate*, *2.5–6 × 0.7–2 cm*, base cuneate, subequal, apex acuminate, acumen to 1.5 cm long; *midrib obscurely sunken above*, slender and elevated below; *venation subdryobalanoid*; main lateral veins *c.* 11 pairs; *intercostal venation reticulate*, *distinct below*; *petiole 0.2–0.4 cm long*, slender. **Inflorescences** racemose, terminal or in axillary pairs, to 9 cm long, slender, remotely irregularly singly or doubly branched, *ascending branches zigzag bearing to 5 remote flowers*; *bracts subpersistent*; bracteoles deltoid, to 2 mm across, subpersistent. **Flowers:** buds small, broadly ovoid, subsessile; petals oblong, deep wine-red, strongly contorted; *stamens c. 15*, anthers subglobose, connectival appendage *c.* 2x as long as anther; *ovary and stylopodium cylindrical*, *truncate*, style short. **Fruits:** *calyx lobes subequal*, *ovate*, *obtuse*, *to 0.5 × 0.5 cm*, conceiling all but the apex of nut. **Nuts** ovoid, to 0.9 × 0.6 cm, with minutely truncate apex.

Vernacular names. Sabah—*selangan* (preferred name). Sarawak—*luis padi* (preferred name).

Distribution. Peninsular Malaysia and Borneo. In Sabah known from Keningau, Kinabatangan, Labuk Sugut, Nabawan, Ranau, Sandakan, and Tawau districts (e.g., *Kamaruddin KMS 3433*, *SAN 38944*, *SAN 83076*, *SAN 83408*, *SAN 128811*, and *SAN 130025*); locally abundant throughout Sarawak and recorded from Belaga, Bintulu, Kuching, Lundu, Miri, and Serian districts (e.g., *S 13347*, *S 18305*, *S 27172*, *S 43517*, and *S 49885*). Also occurring in Brunei (e.g., *BRUN 322*, *BRUN 328*, *BRUN 435*, *FMS 30618*, and *S 5713*).

Ecology. Very local but often abundant in mixed dipterocarp forest on both clay and sandy soils, at altitudes to 650 m. Locally common in Lambir NP but vulnerable elsewhere.

6. **Hopea bullatifolia** P.S.Ashton

(Latin, *bullatus*= blistered, *folius* = a leaf; the quilted leaf blade)

Gard. Bull. Sing. 22 (1967) 274, *op. cit.* (1968) 48, *op. cit.* (1982) 433; Anderson *op. cit.* (1980) 115. **Type:** *Mashor SA 522*, Borneo, Sarawak, Belaga district, Sg. Danum (holotype K; isotype KEP).

Subcanopy tree, to 20 tall, to 20 cm diameter; buttresses low, thin. **Bark** *smooth*. *Young exposed parts including petiole and midrib below densely evenly persistently tawny pubescent*, *venation and lamina below sparsely so*; *parts otherwise apparently glabrous*. **Twigs** *c.* 2 mm diameter apically. **Leaves** thinly coriaceous, *prominently bullate between the intercostal veins*, drying chocolate-brown and darker above, *not silvery below*; *blade oblong*, 16–34 × 4.5–9 cm, *base markedly unequal*, *subcordate*, apex with slender acumen to 1 cm long; *midrib prominent on both surfaces*; *venation hopea-type*; *lateral veins 17–26 pairs*, slender but prominent below, sunken above, often anastomosing within margin; intercostal venation scalariform, lax, raised below, sunken above; petiole 0.3–0.6 cm long, stout. **Inflorescence** and **flower** unknown. **Fruits** subsessile; *calyx lobes unequal*, *2 longer lobes spatulate*, obtuse, to 8 × 1.5 cm, tapering to 3 mm above the saccate base, 3 shorter ones to 1.5 cm long, lanceolate, enclosing and hiding the nut. **Nuts** ovoid, to 1 × 0.7 cm, apiculate.

Vernacular name. Sarawak—*luis melencur* (preferred name).

Distribution. Endemic in Borneo. Known in Sarawak from Belaga, Kapit, Lubok Antu, Sibu, Song, Sri Aman, and Tatau districts (e.g., *S 17730*, *S 43453*, *S 45130*, *S 69663*, and *SFN 35726*). Also occurring in S Kalimantan.

Ecology. Rare, in mixed dipterocarp forest on low shale hills, at altitudes to 200 m. Probably endangered.

7. **Hopea centipeda** P.S.Ashton Fig. 13.

(Latin, *centi-* = hundred, *pes* = a foot; the stilt roots)

Gard. Bull. Sing. 22 (1967) 274, *op. cit.* (1968) 48, *op. cit.* (1982) 423; Anderson *op. cit.* (1980) 115; Coode *et al.* (eds.) *op. cit.* 71. **Type:** *Murthy & Ashton S 23342*, Borneo, Sarawak, Marudi district, Ulu Dapoi, Tinjar (holotype K; isotypes KEP, L). **Synonym:** *Hopea acuminata auct. non.* Merr.: Ashton *op. cit.* (1964) 94, Coode *et al.* (eds.) *op. cit.* 71.

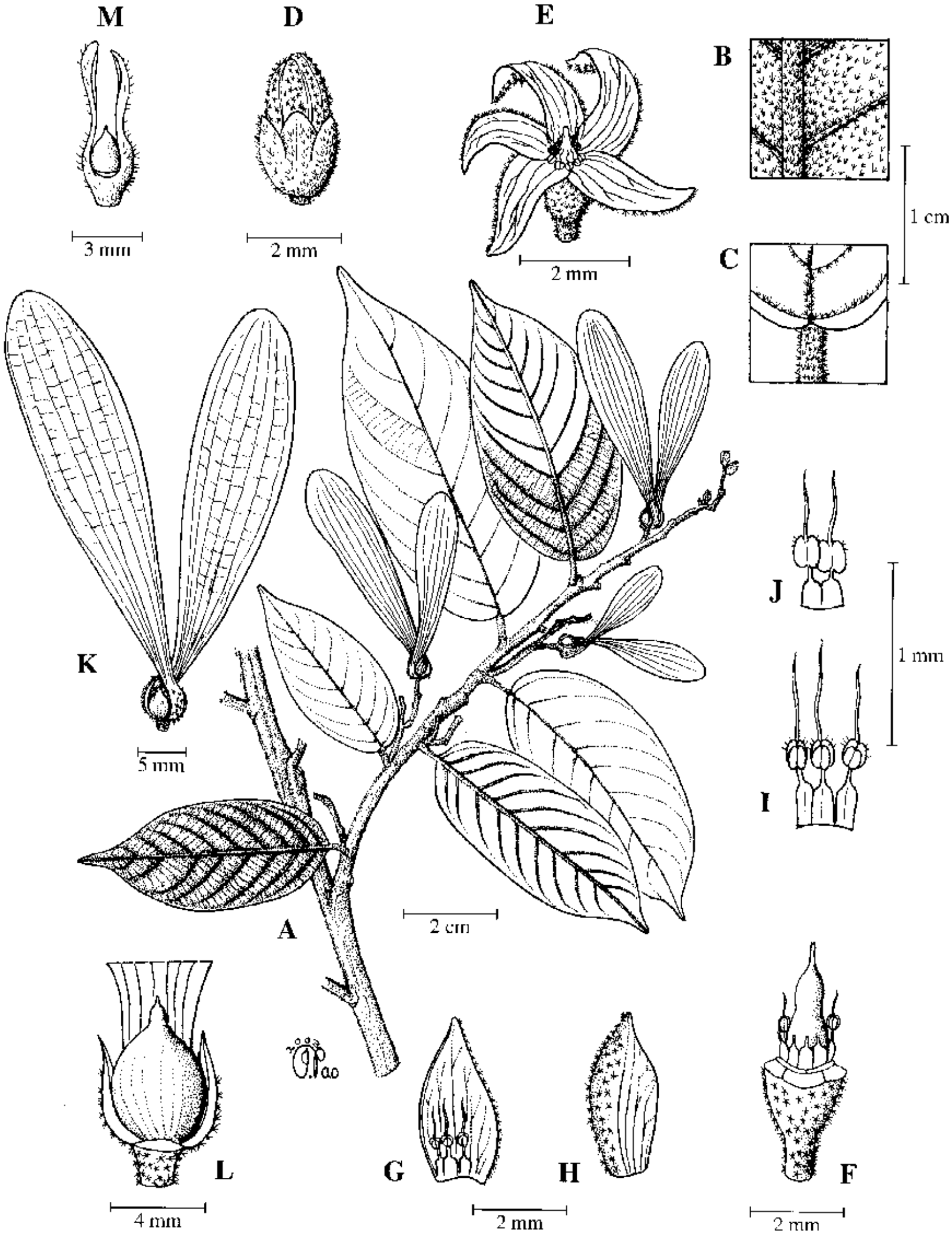

Fig. 13. *Hopea centipeda*. A, fruiting leafy twig; B, detail of indumentum on lower leaf surface; C, detail of indumentum on upper leaf surface; D, flower bud; E, open flower; F, gynoecium; G, adaxial view of petal with stamens; H, abaxial view of petal; I, adaxial view of stamens; J, abaxial view of stamens; K, fruit; L, partially exposed nut; M, fruit with the large calyx lobes removed. (A–C and K–L from *SAN 124740*, D–J and M from *S 23342*.)

Canopy tree, to 30 m tall, to 60 cm diameter, often remaining monopodial with pendent branches and diffuse foliage; *bole with abundant flying buttresses and stilt roots to 3 m*; **Sapwood** soft, pale. **Bark** *smooth*. *Young leaf shoots including leaf venation below and petiole*, *inflorescence and parts of flower exposed in bud persistently shortly greyish brown puberulent*; *parts otherwise glabrous*. **Twigs** *c.* 1 mm diameter apically, slender. **Leaves** chartaceous, drying pale yellowish grey; *blade lanceolate*, 5.5–9 × 1.5–3.5 cm, *base subequal*, cuneate, apex caudate, acumen to 1.5 cm long; *midrib* prominent below, *narrow and sunken above*; *venation hopea-type*; *lateral veins 7–9 pairs*, prominent below, somewhat arched, with prominent tomentose axillary domatia; intercostal venation slender, subscalariform; petiole 0.4–0.7 cm long, slender. **Inflorescences** to 2 cm long, axillary, *flowers dense*; *bracts fugaceous*. **Flowers:** buds lanceolate, to 6 × 2 mm; petals cream to pink at base, oblong; *stamens c. 15*, anthers subglobose, connectival appendage *c.* 3x the length of anther; *ovary and stylopodium pyriform*, *style prominent*, *as long as ovary and equal to stylopodium*. **Fruits:** pedicel *c.* 1 mm long, slender; calyx lobes unequal, 2 longer lobes spatulate, obtuse, to 3 × 0.8 cm, tapering to 1.5 mm above the saccate base, 3 shorter ones ovate, to 0.4 × 0.3 cm. **Nuts** ovoid, to 0.4 × 0.3 cm, apiculate.

Vernacular name. Sarawak—*luis daun berbulu* (preferred name).

Distribution. Endemic in Borneo. In Sabah recorded from Nabawan and Tawau districts (e.g., *SAN 62794* and *SAN 124740*) and in Sarawak from Belaga, Bintulu, Kapit, Marudi, and Miri districts (e.g., *S 22649*, *S 22682*, *S 23010*, *S 23012*, and *S 43577*). Also occurring in Brunei (e.g., *BRUN 125*, *BRUN 127* and *S 5750*).

Ecology. Locally common along the banks of swift-flowing rivers, on shale and silt, at altitudes to 300 m. Frequently flowering and fruiting. Vulnerable.

8. **Hopea cernua** Teijsm. & Binn.

(Latin, *cernuus* = slightly drooping; the flowers)

Nat. Tijd. Ned. Ind. 29 (1867) 252; Merrill *op. cit.* (1921) 402; Masamune *op. cit.* 490; Ashton *op. cit.* (1968) 49, *op. cit.* (1978) 28, *op. cit.* (1982) 398; Anderson *op. cit.* (1980) 115; PROSEA *op. cit.* 245; Kessler & Sidiyasa *op. cit.* 97; Coode *et al.* (eds.) *op. cit.* 71; Newman *et al. op. cit.* 147. **Lectotype** (designated here)**:** *Binnendijk s.n.*, Sumatra (hololectotype K). **Synonyms:** *Hancea cernua* (Teijsm. & Binn.) Pierre *op. cit.* (1891) *t.* 244; *Hopea argentea* Meijer, Act. Bot. Neerl. 12 (1963) 348, Meijer & Wood *op. cit.* 207, Burgess *op. cit.* 128, Ashton *op. cit.* (1968) 47.

Canopy tree, to 40 m tall, to 80 cm diameter, *with prominent flying buttresses and stilt roots*. **Bark** *becoming cracked and eventually v-section fissured*, *chocolate-brown*; *inner bark pale brown*. *Leaf bud, young twig and petiole fugaceous greyish brown puberulent*; *parts otherwise glabrous*. **Twigs** *c.* 1 mm diameter apically, slender. **Leaves** *thinly coriaceous*, often somewhat silvery lepidote below, drying greyish tawny with the veins often darker below; *blade elliptic to ovate*, *5–15 × 2–5 cm*, *base cuneate*, *unequal*, *margin frequently narrowly shallowly revolute*, apex with acumen to 0.6 cm long; *midrib terete below*, *slender and elevated above*, *not drying black*; *venation dryobalanoid*, slender but generally distinctly elevated below, often with a few axillary pubescent pore-like domatia; *main lateral veins 10–12 pairs*, *distinctly raised below*, *basal pairs short*, *drying blackish*; petiole 0.7–0.9 cm long, slender. **Inflorescences** terminal or axillary, singly branched, to 3 cm long. **Flowers:** buds spindle-shaped, to 5 × 4 mm, relatively large; petals lanceolate, cream; *stamens 15–18*, anthers subglobose, connectival appendage 2–3x the length of anther; *ovary ovoid*, *without stylopodium*, *style columnar*, *c. 1½x as long as ovary*, villous towards base. **Fruits:** pedicels *c.* 2 mm long; calyx lobes unequal, 2 longer lobes spatulate, obtuse, to 6.5 × 1.2 cm, tapering to 4 mm obove the saccate but rather broad, 0.5 × 5 mm base, *3 shorter ones lanceolate*, *to 1.5 cm long*, *conceiling the nut*. **Nuts** ovoid, to 0.7 × 0.5 cm, apiculate.

Vernacular names. Sabah—*selangan urat* (preferred name). Sarawak—*luis timbul* (preferred name).

Distribution. Sumatra and Borneo. Throughout Sabah and recorded from Kinabatangan, Lahad Datu, Ranau, Sandakan, Sipitang, Tawau, and Tenom districts (e.g., *SAN 16367*, *SAN 22090*, *SAN 23260*, *SAN 24252*, *SAN 35861*, and *SAN A 4049*) and in Sarawak known from Bau, Bintulu, Kapit, Kuching, Lundu, Miri, and Serian districts (*S 15448*, *S 24040*, *S 25647*, *S 32660*, and *S 60129*). Also occurring in Brunei (e.g., *BRUN 2359* and *BRUN 2532*) and E Kalimantan (e.g., *Kostermans 6032*, *Kostermans 13838*, *Sidiyasa 439*, and *Sidiyasa 539*).

Ecology. In forest on organic soils over limestone in the lowlands and in upper dipterocarp forest, at 1000–1650 m altitude; also on igneous rocks. Very local, vulnerable.

9. **Hopea coriacea** Burck

(Latin, *coriaceus* = leathery; the leaf blade)

Ann. Jard. Bot. Buitenz. 6 (1887) 237; Merrill *op. cit.* (1921) 402; Masamune *op. cit.* 490; Ashton *op. cit.* (1978) 28, *op. cit.* (1982) 398; Anderson *op. cit.* (1980) 115; PROSEA *op. cit.* 260; Coode *et al.* (eds.) *op. cit.* 71; Newman *et al. op. cit.* 148. **Type:** *Teijsmann s.n.*, Borneo, Kalimantan (holotype BO; isotype L). **Synonyms:** *Hopea kelantanensis* Symington, J. Malay. Br. Roy. As. Soc. 19 (1941) 144; *H. garangbuaya* P.S.Ashton, Gard. Bull. Sing. 19 (1962) 256, *op. cit.* (1964) 101, *op. cit.* (1968) 51.

Large canopy or low emergent tree, to 45 m tall, to 1.5 m diameter; crown dense hemispherical; buttresses to 1.5 m tall, to 8 cm thick, concave or convex; *stilt roots few or none*. **Bark** *smooth to flaky or deeply v-section fissured*, greyish to chocolate-brown; *inner bark pale brown or pink*. **Sapwood** straw-yellow, hard; heartwood dark chocolate-brown. *Parts glabrous but for pubescent parts of petals exposed in bud.* **Twigs** *c.* 2 mm diameter apically, stout. **Leaves** *thickly coriaceous*, drying pale chocolate-brown below, yellowish brown above; *blade broadly ovate or suborbicular*, *11–16 × 6–10 cm*, base equal, obtuse, *margin revolute*, apex acuminate, acumen to 1.2 cm long, narrow; *midrib* prominently terete below, *slightly elevated though stout above*; *venation dryobalanoid*, sharply elevated below, strongly arched; *main lateral veins 8–11 pairs or sometimes at most 4 pairs*, with short intermediates; intercostal venation scalariform, distinctly elevated below; petiole 2–2.5 cm long, stout. **Inflorescences** terminal or in axillary pairs, to 9 cm long, singly branched, branchlets bearing to 6 secund flowers. **Flowers:** buds ellipsoid, to 3 × 2.5 mm, large, distinctly pedicellate; petals lanceolate, to 1.3 cm long, cream; *stamens c. 15*, anthers oblong, connectival appendage 2–3x the length of anther, tuberculate towards base; *ovary ovoid*, *style as long as ovary*, *columnar*, setose towards base and onto ovary apex, *stylopodium obscure.* **Fruits:** calyx lobes unequal, 2 longer lobes to 7 × 1.5 cm, hardly tapering to the narrowly auriculate saccate base, *3 shorter ones* ovate to lanceolate, to 2 × 1.2 cm, *conceiling the nut*, similar at base. **Nuts** narrowly ovoid, to 1.8 × 0.9 cm, with to 2 cm long filiform style remnant, often resinous.

Vernacular name. Sarawak—*garang buaya* (preferred name).

Distribution. Peninsular Malaysia and Borneo. In Borneo known in Sarawak from Bintulu, Limbang, and Lundu districts (e.g., *S 10395*, *S 12610*, *S 18340*, *S 18855*, and *S 66799*). Also occurring in Brunei (e.g., *BRUN 713*, *BRUN 2006A*, *BRUN 3347*, *and S 5768*) and Kalimantan (e.g., the type, *bb. 7699* and *bb. 35251*).

Ecology. In mixed dipterocarp forest and along the banks of small rivers, on yellow sandy soils, at altitudes below 400 m. Rare and critically endangered by logging and forest conversion.

10. **Hopea depressinerva** P.S.Ashton

(Latin, *depressus* = sunken, *nervus*= nerve/vein; the sunken veins on leaf upper surface)

Gard. Bull. Sing. 22 (1967) 275, *op. cit.* (1968) 50, *op. cit.* (1982) 420; Anderson *op. cit.* (1980) 115; PROSEA *op. cit.* 260. **Type:** *Anderson S 15439*, Borneo, Sarawak, Lundu district, Bt. Gebong (holotype K; isotypes KEP, L).

Subcanopy or canopy tree, to 25 m tall, to 50 cm diameter. **Bark** *brown*, *becoming cracked along lines of lenticels*; *damar exudation not conspicuous. Parts glabrescent but for densely buff-pubescent inflorescence and parts of flower exposed in bud.* **Twigs** 1–2 mm diameter apically, slender. **Leaves** thinly coriaceous, *undulate*, drying pale greyish brown, *not pale lepidote below*; *blade lanceolate to narrowly elliptic*, 5–13 × 2–5 cm, *base cuneate*, *equal*, apex with slender acumen to 1.5 cm long; *venation hopea-type*; *lateral veins 6–8 pairs*, *slender but distinctly raised below*, obscure and sunken above, *domatia obscure or absent*; intercostal venation densely scalariform, slender, not elevated; petiole 1.1–1.3 cm long, slender. **Inflorescences** terminal or axillary, to 7 cm long, singly branched, *branchlets bearing to 5 secund dense flowers*; *bracts fugaceous*. **Flowers:** buds ellipsoid, to 3 × 2 mm; petals elliptic, pink; *stamens c. 10*, anthers subglobose, connectival appendage c. 2x the length of anther; *ovary and stylopodium cylindrical*, *truncate*, style short. **Mature fruits** unknown; calyx lobes unequal, 2 larger lobes aliform.

Distribution. Endemic in Borneo; known so far from G. Pueh and Bt. Gebong, Lundu district in W Sarawak (e.g., *S 395*, *S 15516* and the type).

Ecology. Very local, apparently uncommon in mixed dipterocarp forest on deep sandy loam soils over granodiorite, at altitudes to 500 m. Conservation status unknown, but likely vulnerable.

11. **Hopea dryobalanoides** Miq. Fig. 14.

(Greek, *dryobalanoides* = resembling *Dryobalanops*; the leaf venation)

Fl. Ned. Ind., Suppl. (1862) 492; Symington *op. cit.* (1939) 345; Browne *op. cit.* 120; Ashton *op. cit.* (1963) 259, *op. cit.* (1964) 50, *op. cit.* (1968) 50, *op. cit.* (1982) 402; Meijer & Wood *op. cit.* 209; Burgess *op. cit.* 129; Anderson *op. cit.* (1980) 115; PROSEA *op. cit.* 246; Kessler & Sidiyasa *op. cit.* 97; Coode *et al.* (eds.) *op. cit.* 71; Newman *et al. op. cit.* 149. **Type:** *Teijsmann s.n.*, Sumatra, Pariaman, Padang (holotype U). **Synonyms:** *Hancea dryobalanoides* (Miq.) Pierre *op. cit. t.* 244; *Hopea sarawakensis* F.Heim *op. cit.* (1891) 971; *Hopea borneensis* F.Heim *op. cit.* (1891) 972.

Large canopy or low emergent tree, to 45 m tall, to 1.3 m diameter; buttresses to 2 m tall, thin, concave, spreading; *stilt roots present on young trees*. **Bark** becoming fawn brown, *vertically cracked and powdery thinly oblong flaky*, with coxcombs of glassy dammar; *inner*

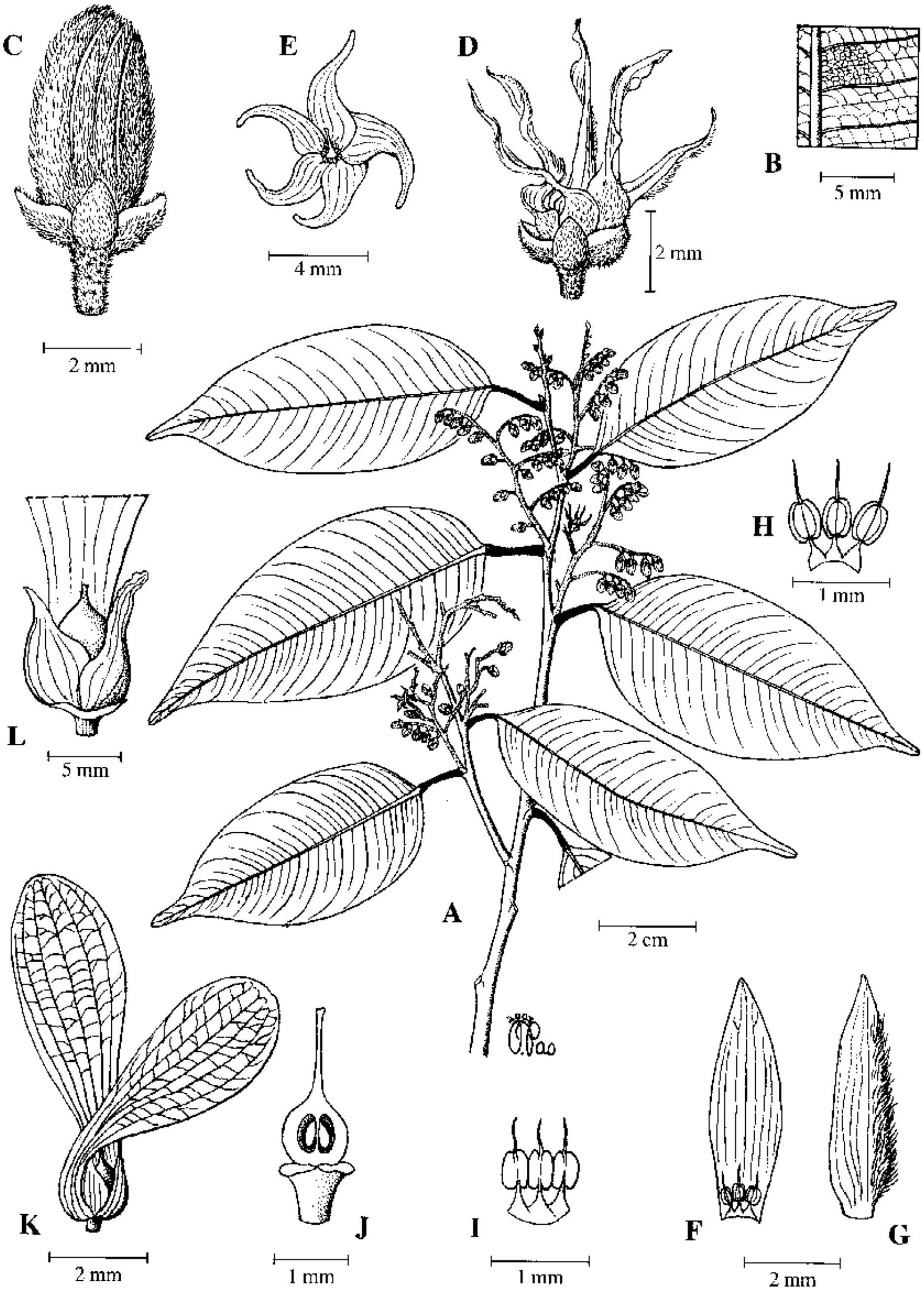

Fig. 14. *Hopea dryobalanoides*. A, flowering leafy twig; B, detail of venation on lower leaf surface; C, flower bud; D, side view of open flower; E, top view of open flower; F, adaxial view of petal with stamens; G, abaxial view of petal; H, adaxial view of stamens; I, abaxial view of stamens; J, longitudinal section of gynoecium; K, fruit; L, fruit with the large calyx lobes removed. (A–J from *SAN 15186*, K–L from *SAN 100048*.)

bark pale brown or pink. *Young parts including leaf below*, *petiole*, *inflorescence and parts of flower exposed in bud densely greyish brown fugaceous-puberulent*. **Twigs** *c*. 1 mm diameter apically, slender, drying blackish. **Leaves** *chartaceous* or thinly coriaceous, drying dull leaden brown below; *blade ovate-lanceolate*, 5–12 × 1.5–4.5 cm, *base cuneate*, *equal to subequal*, apex subcaudate, acumen to 2 cm long; *midrib raised and terete or sharp on both surfaces*, *more so below*, *drying black or not*; *venation dryobalanoid*; *main lateral veins 8–12 pairs*, with a few short intermediates, *slender but distinct and somewhat elevated below*, *arched*, *drying paler or darker than the blade*, sometimes with a few small glabrous pore-like axillary domatia; petiole 0.5–1 cm long, slender, drying blackish. **Inflorescences** terminal or in axillary pairs, lax, singly branched, branchlets to 5 cm long, bearing to 6 flowers. **Flowers:** buds small, broadly ovoid; petals lanceolate, cream-yellow; stamens *c*. 15, anther subglobose, connectival appendage *c*. 2x the length of anther; *ovary ovoid*, *stylopodium obscure*, *style filiform*, *as long as ovary*, villous towards base. **Fruits:** pedicels to 2 mm long; *calyx lobes unequal*, *2 longer lobes strongly twisted*, *spatulate*, *subacute*, *to 6.5 × 1.5 cm*, *tapering to 5 mm above the saccate base*, *3 shorter ones* broadly ovate, obtuse or subacute, to 0.8 × 0.6 cm, *shorter than the nut*. **Nuts** *broadly ovoid*, *to 1 × 0.8 cm*, with to 1.5 mm filiform style remnant.

Vernacular names. Sabah—*selangan daun kapur* (preferred name). Sarawak—*mata kucing hitam* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah widespread and recorded from Beaufort, Kinabatangan, Kota Kinabalu, Kudat, Labuk Sugut, Lahad Datu, Ranau, Semporna, Tawau, and Tenom districts (e.g., *SAN 16837*, *SAN 19335*, *SAN 22654*, *SAN 22849*, and *SAN 24514*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lawas, Limbang, Lundu, Miri, Serian, Sibu, and Tatau districts (e.g., *S 7972*, *S 15249*, *S 22476*, *S 28172*, and *S 43827*). Also occurring in Brunei (e.g., *BRUN 3376*, *BRUN 5230* and *BRUN 5376*) and E Kalimantan (e.g., *Kostermans 13518*, *Kostermans 13867* and *Sidiyasa 707*).

Ecology. Locally abundant in mixed dipterocarp forest on clay-rich soils, especially on intermediate to basic igneous and volcanic rocks but also sedimentaries, at altitudes to 600 m. Well represented in Kinabalu NP, Sepilok FR and Danum Valley Conservation Area in Sabah and Lambir and Mulu NPs in Sarawak; not vulnerable.

Uses. Formerly a major source of *damar mata kucing*, yielding a high quality resin.

Notes. One of the largest of the dryobalanoid *Hopea* species, with flaky bark and prominent thin buttresses. The leaf dries a distinctive greenish grey with distinct curved lateral veins, black drying midrib below and long black petiole (*cf. H. beccariana*).

12. **Hopea dyeri** F.Heim

(J.T. Thiselton-Dyer, 1824–1928, a British botanist, one time Director of the Royal Botanic Gardens, Kew)

Bull. Mens. Soc. Linn. Paris 2 (1891) 972; Merrill *op. cit.* (1921) 402; Symington *op. cit.* (1939) 353; Masamune *op. cit.* 490; Browne *op. cit.* 120; Ashton *op. cit.* (1964) 99, *op. cit.* (1968) 50, *op. cit.* (1982) 407; Meijer & Wood *op. cit.* 210; Burgess *op. cit.* 129; Anderson *op. cit.* (1980) 116; PROSEA *op. cit.* 246; Coode *et al.* (eds.) *op. cit.* 71. **Type:** *Beccari PB 2962*, Borneo, Sarawak, Matang (holotype P). **Synonym:** *Hopea intermedia* King *op. cit.* 126, *p.p.*

Medium-sized canopy tree, to 40 m tall, to 65 cm diameter; crown narrowly hemispherical; bole frequently misshapen, with low narrow buttresses and *a few stilt roots*. **Bark** *smooth*, *becoming patchily flaky*, sometimes with yellowish dammar exudations; *inner bark pale brown or pink*. **Sapwood** yellowish. *Bud*, *stipules*, *inflorescence*, *outside of petals and domatia sparsely or densely greyish brown puberulent*; *twig*, *petiole and parts of calyx exposed in bud caducously so*. **Twigs** *c*. 1 mm diameter apically, slender, much-branched. **Leaves** *coriaceous*, frequently lepidote below, drying greyish brown; *blade ovate-lanceolate*, 2.7–7 × 1.2–2.5 cm, *base unequal*, *cuneate*, margin often slightly revolute, apex caudate, acumen to 1.5 cm long; *midrib terete and raised on both surfaces*, *more so above*, *not drying black*; *venation dryobalanoid*; *main lateral veins 8–12 pairs* with many intermediates, *distinct and somewhat elevated below*, the longest subequal, *basal pairs short*; *petiole 0.5–0.8 cm long*, slender. **Inflorescences** terminal or axillary, to 3 cm long, singly or doubly shortly branched, branchlets bearing to 4 flowers. **Flowers:** buds small, ovoid; petals narrowly lanceolate, cream; *stamens c. 15*, anthers subglobose, connectival appendage *c*. 3x the length of anther; *ovary and stylopodium pyriform*, villous towards apex, *style short*. **Fruits:** calyx lobes unequal, 2 longer lobes spatulate, narrowly obtuse, to 2.5 × 1 cm, tapering to 2.5 mm above the saccate base, 3 shorter ones ovate, acute to subacuminate, to 0.7 × 0.4 cm, shorter than the nut. **Nuts** ovoid, to 0.9 × 0.4 cm, with vestigial stylopodium and subacute style remnant.

Vernacular names. Sabah—*selangan daun halus* (preferred name). Sarawak—*luis palit* (preferred name).

Distribution. Peninsular Malaysia and Borneo. In Sabah recorded from Keningau, Labuk Sugut, Ranau, Sandakan, Sipitang, and Tawau districts (e.g., *SAN 19452*, *SAN 21506*, *SAN 41082*, *SAN 66241*, and *SAN 99285*) and in Sarawak from Bintulu, Kapit, Kuching, Lawas, Lubok Antu, Miri, Samarahan, and Serian districts (e.g., *S 15219*, *S 23962*, *S 24655*, *S 41114*, and *S 69631*). Also occurring in Brunei (e.g., *BRUN 876*, *BRUN 3068* and *BRUN 3180*) and C and E Kalimantan (e.g., *bb. 24781* and *Ridsdale PBU 593*).

Ecology. Locally common in mixed dipterocarp forest on sandy and sandy clay soils, on low hills and along sandstone ridges, occasionally at altitudes to 1000 m but usually lower. Occurring in Kubah NP, Sarawak; regeneration abundant; probably not vulnerable.

Notes. This species one of a group of small-leaved and small-fruited dryobalanoid-veined *Hopea* species, also notebly including *H. ferruginea*, *H. micrantha* and *H. vesquei*, which can be difficult to identify on field characters alone. The leaf of *H. micrantha* is obtuse at base, but that of the others is cuneate, and the leaf dries pink not coppery brown. The twigs and petioles of *H. vesquei* are densely persistently puberulent, but the leaf is shorter and broader with unequal base, and more coriaceous than the other species. Variability in leaf size and texture of *H. dyeri* as recognised here suggests that fertile material of *H. vesquei* may yet to be found east of Batang Lupar (Sarawak).

13. **Hopea enicosanthoides** P.S.Ashton

(Greek, resembling *Enicosanthum*, Annonaceae; the leaf)

Gard. Bull. Sing. 22 (1967) 276, *op. cit.* (1968) 50, *op. cit.* (1982) 436; Anderson *op. cit.* (1980) 116. **Type:** *Ashton S 18116*, Borneo, Sarawak, Bintulu district, Ulu Labang (holotype K; isotypes KEP, L).

Small tree, to 18 m tall, to 20 cm diameter; crown monopodial, with pendent branches and leaves; buttresses low, thin; stilt roots few. **Bark** *smooth*. *Young parts including petiole and base of midrib above more or less caducous tawny pubescent.* **Twigs** *c.* 3 mm diameter apically, often somewhat compressed, ribbed below the petiole insertion. **Leaves** *thinly coriaceous*, *somewhat convex between the veins above*, *drying greenish to rust-brown*; *blade very large*, *oblong*, *27–46 × 8–15 cm*, *base unequal*, *cordate*, apex with slender acumen to 2.5 cm long; *midrib* evident but furrowed above, *prominent below*; *venation hopea-type*; *lateral veins 16–30 pairs*, *slender but prominent below*; intercostal venation densely scalariform, evident but unraised below; petiole 0.5–0.8 cm long, stout. **Inflorescences** *in axillary pairs or ramiflorous*, slender, lax, to 12 cm long, singly branched, branchlets bearing to 5 flowers. **Flowers:** unknown. **Fruits** subsessile; *calyx lobes unequal*, *2 longer lobes broadly spatulate*, obtuse, to 13 × 3 cm, *tapering to 6 mm above the saccate base*, 3 shorter ones lanceolate, acute, to 2 cm long, similar at base, conceiling the nut. **Nuts** ovoid, to 1 × 0.6 cm, with 2 mm long filiform style remnant.

Vernacular name. Sarawak—*luis selukai* (preferred name).

Distribution. Endemic in Borneo and known only from Bintulu, Kapit and Miri districts in Sarawak (e.g., *S 1467*, *S 1470*, *S 13200*, *S 18304*, *S 37686*, and *S 69631*).

Ecology. On the banks of sluggish eutrophic rivers and moist slopes by streams, at altitudes below 100 m, locally abundant; but killed by prolonged immersion in turbid water. Probably endangered.

14. **Hopea ferruginea** Parijs

(Latin, *ferrugineus* = rust-coloured; the indumentum)

In Fedde, Rep. 33 (1933) 243; Symington *op. cit.* (1939) 349, *op. cit.* (1943) 125; Masamune *op. cit.* 490; Meijer & Wood *op. cit.* 211; Burgess *op. cit.* 129; Ashton *op. cit.* (1982) 404; PROSEA *op. cit.* 247; Coode *et al.* (eds.) *op. cit.* 71. **Type:** *bb. 14459*, Sumatra, Jambi (holotype BO; isotype L).

Medium-sized canopy tree, to 40 m tall, to 70 cm diameter, *with thin buttresses and stilt roots*. **Bark** *smooth*, *becoming thinly flaky*, with clear globular dammar exudations; *inner bark pale brown or pink. Young twigs*, *petiole*, *midrib above*, *inflorescence*, *and parts of flower exposed in bud sparsely but persistently greyish to rust-brown puberulent*, *or glabrescent.* **Twigs** *c.* 1 mm diameter apically, slender, blackish. **Leaves** *thinly coriaceous*, drying greyish brown; *blade narrowly ovate-lanceolate*, 4.5–7.5 × 1.5–4 cm, *base cuneate*, *unequal*, shortly decurrent, apex caudate, acumen to 1.5 cm long; *midrib terete*, *slender*, *elevated on both surfaces*, *not drying black*; *venation dryobalanoid*; *main lateral veins c. 14 pairs*, *basal pairs short*, with many subequal intermediates, *somewhat raised below*, with prominent axillary domatia in juveniles; *petiole 0.6–1 cm long*, slender. **Inflorescences** axillary, to 2 cm long, with short branchlets bearing to 4 secund flowers. **Flowers:** buds ellipsoid, to 3 × 2 mm; petals lanceolate, pale yellow; stamens *c.* 15, anther subglobose, connectival appendage *c.* 2x the length of anther; *ovary ovoid*, *stylopodium obscure*, *style columnar*, *as long as ovary*, villous towards base or glabrous. **Fruits:** pedicels to 2 mm long, very slender; *calyx lobes unequal*, *2 longer lobes spatulate*, *narrowly obtuse*, *to 3 × 0.5 cm*, *tapering to 1.5 mm above the saccate base*, *3 shorter ones ovate-acuminate*, *to 0.8 × 0.4 cm*, *closely clasping and conceiling the ripe nut.* **Nuts** *ovoid*, *to 0.7 × 0.4 cm*, apiculate.

Vernacular name. Sabah—*selangan mata kucing* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo common and widespread. In Sabah recorded from Kinabatangan, Kota Belud, Kudat, Lahad Datu, Sandakan, Sipitang, and Tawau districts (e.g., *SAN 15358*, *SAN 19380*, *SAN 26590*, and *SAN 67737*) and in Sarawak from Lawas, Limbang and Miri districts (e.g., *Nooteboom 2332*, *S 31527* and *S 39619*). Also occurring in Brunei (e.g., *BRUN 3375*) and E Kalimantan (e.g., *bb. 14974*).

Ecology. In mixed dipterocarp forest on clay-rich soils and along ridges in upper dipterocarp forest, at altitudes to 750 m. Locally common and occurring in Kinabalu NP, but vulnerable.

Notes. Sterile specimens of this species is not easily distinguishable from those of *H. dyerii* (see there).

15. **Hopea fluvialis** P.S.Ashton

(Latin, *fluviatilis* = pertaining to rivers; the natural habitat)

Gard. Bull. Sing. 19 (1962) 254, *op. cit.* (1964) 100, *op. cit.* (1968) 51, *op. cit.* (1982) 399; Anderson *op. cit.* (1980) 116; PROSEA *op. cit.* 247; Coode *et al.* (eds.) *op. cit.* 71. **Type:** *Flemmich FMS 34523*, Brunei, Belait district, Sg. Melayan (holotype KEP).

Medium-sized leaning riverbank tree, to 25 m tall, to 80 cm diameter, *with or without low buttresses and stilt roots*. **Bark** *smooth*; *inner bark pale brown or pink*. **Sapwood** whitish, relatively soft. *Young parts shortly densely greyish brown puberulent*; *indumentum persistent on twig*, *bud*, *stipule*, *inflorescence and petiole*, *caducous elsewhere*. **Twigs** *c.* 1.5 mm diameter apically. **Leaves** chartaceous to thinly coriaceous, drying greyish brown; *blade ovate-lanceolate*, somewhat falcate, 7–12 × 2.8–4.8 cm, *base unequal*, cuneate, *margin not revolute*, apex subcaudate, acumen to 1.5 cm long; *midrib stout*, *terete*, *hardly raised below*, *more prominently so above*, *not drying black*; *venation dryobalanoid*; *main lateral veins c. 10 pairs* with many long intermediates, *the basal pair extending to one third the length of the blade margin*; intercostal venation evident below, reticulate; petiole 0.7–1 cm long. **Inflorescences** in axillary clusters of 3, or rarely terminal, to 6 cm long, singly or doubly branched, branchlets bearing to 7 secund flowers. **Flowers:** buds to 5 × 3 mm; petals lanceolate, cream; stamens *c.* 15, anthers subglobose, connectival appendage *c.* 2x the length of anther; *ovary ovoid*, *stylopodium obscure*, *style columnar tapering*, *as long as ovary*. **Fruits** erect; *pedicels to 2 mm long*, slender; *calyx lobes unequal*, *2 longer lobes broadly spatulate*, *obtuse*, *to 5 × 1 cm*, *subauriculate and hardly tapering into the saccate base*, *3 shorter ones unequal*, *lanceolate*, *acute*, *1–2.5 cm long and conceiling the nut*. **Nuts** narrowly ovoid, to 1.1 × 0.6 cm, tapering to a short apiculus.

Vernacular name. Sarawak—*luis air* (preferred name).

Distribution. Endemic in Borneo. In Sabah recorded from Kinabatangan, Labuk Sugut and Sandakan districts (e.g., *SAN 37886*, *SAN 94100* and *SAN 99580*) and in Sarawak from Belaga, Bintulu, Kapit, Lawas, Marudi, Miri, and Tatau districts (e.g., *S 3433*, *S 15577*, *S 23489*, *S 25024*, and *S 41429*). Also occurring in Brunei (e.g., *BRUN 3394*, *BRUN 5668*, *FMS 34492*, *Forman 1165*, and *Prance 30711*) and Kalimantan (e.g., *bb. 20448*).

Ecology. Locally common in forest on clay-rich river banks, both fast and sluggish, at altitudes to 200 m. Fruiting frequently. Common in Mulu NP; probably not vulnerable.

16. **Hopea griffithii** Kurz

(W. Griffith, 1810–1845, surgeon in the British East India Company at Malacca, Peninsular Malaysia)

J. As. Soc. Beng. 42, 2 (1873) 60; Symington *op. cit.* (1939) 343, *op. cit.* (1943) 127; Ashton *op. cit.* (1968) 51, *op. cit.* (1982) 406; Anderson *op. cit.* (1980) 116; PROSEA *op. cit.* 248; Coode *et al.* (eds.) *op. cit.* 72; Newman *et al. op. cit.* 150. **Type:** *Griffith 717*, Myanmar, Mergui, Tennaserim (holotype CAL; isotype K). **Synonym:** *Hancea griffithii* (Kurz) Pierre *op. cit. t.* 248.

Canopy tree, to 40 m tall, to 60 cm diameter, with even hemispherical crown and *thin, flying buttresses and stilt roots to 1 m tall.* **Bark** *smooth becoming cracked in older trees. Parts glabrous but for pubescent parts of petals exposed in bud.* **Twigs** *c.* 1 mm diameter apically, slender, much-branched. **Leaves** coriaceous, shiny and drying purplish brown above, tawny brown below; blade ovate to lanceolate, 4–9 × 1.7–4.5 cm, base cuneate, margin frequently subrevolute, apex subcaudate, acumen to 1.5 cm long; *midrib obscure*, *sunken above*, prominent below; *venation dryobalanoid*, with the veins hardly evident; *main lateral veins c. 9 pairs*, with shorter intermediates, *without domatia*; *intercostal venation obscure*, reticulate; petiole 0.8–1.5 cm long, slender. **Inflorescences** terminal or axillary, to 2.5 cm long, singly branched, branchlets bearing to 5 secund flowers. **Flowers:** buds ellipsoid, to 2 mm long; petals lanceolate, dark red; stamens *c.* 15, anthers broadly ellipsoid, connectival appendage *c.* 2x the length of anther; *ovary and stylopodium stoutly pyriform*, papillose towards apex, *tapering abruptly to the short columnar style.* **Fruits:** pedicels *c.* 1 mm long; calyx lobes unequal, 2 longer lobes spatulate, obtuse, to 3 × 0.5 cm, tapering to 2 mm above the saccate base; 3 shorter ones linear, to 0.8 × 0.1 cm. **Nuts** ovoid, to 0.7 × 0.5 cm, apiculate.

Vernacular name. Sarawak—*luis jantan* (preferred name).

Distribution. Peninsular Myanmar, Peninsular Thailand, Peninsular Malaysia, and Borneo. In Borneo, rare in Sabah and known from Kota Marudu and Ranau districts (e.g., *SAN 25334* and *SAN 100048*) but widespread in Sarawak with most records in the west, from Kapit, Kuching, Lundu, Serian, and Simunjan districts (e.g., *S 9338*, *S 10052*, *S 22267*, *S 32534*, and *S 37154*). Also occurring in Brunei (e.g., *BRUN 786*, *BRUN 3362* and *BRUN 5249*) and W Kutei in NE Kalimantan (e.g., *bb. 8205*, *bb. 20133* and *Hallier 2225*).

Ecology. In mixed dipterocarp forests on leached yellow clay soils, at altitudes to 500 m. Locally common. Vulnerable.

17. **Hopea kerangasensis** P.S.Ashton

(from Iban word—*kerangas* = a type of soil not suitable for cultivating rice; the natural habitat)

Gard. Bull. Sing. 22 (1967) 277, *op. cit.* (1968) 52, *op. cit.* (1982) 401; Anderson *op. cit.* (1980) 116. **Type:** *Yakup S 8944*, Borneo, Sarawak, Kuching district, Semengoh FR (holotype K; isotype L).

Subcanopy or small canopy tree, to 30 m tall, to 35 cm diameter; crown diffuse, at first remaining monopodial; *buttresses*, *flying buttresses and a few stilt roots to 1 m tall*. **Bark** *smooth*. *Twig*, *petiole*, *midrib above*, *domatia below*, *bud*, *and inflorescence more or less densely persistently tawny puberulent*, *more or less caducous*. **Twigs** *c.* 0.5 mm diameter apically, very slender. **Leaves** chartaceous, drying purplish brown above, deep tawny below; blade ovate, 1.5–4.5 × 1–3 cm, base broadly cuneate, apex caudate, acumen to 1 cm long; *midrib shallowly sunken above*, slender but prominent below; *venation dryobalanoid*; *main lateral veins c. 6 pairs* with short intermediates, slightly sunken above, *slender but distinctly raised below*, *with prominent pubescent domatia*; *intercostal venation obscure*, reticulate; petiole 0.3–0.5 cm long, slender. **Inflorescences** axillary, to 1.2 cm long, singly branched, branchlets bearing to 3 distichous flowers. **Flowers:** buds ovoid, to 1.5 × 1 mm; petals lanceolate, cream; stamens *c.* 15, anthers subglobose, connectival appendage 2–3x the length of anther; *ovary ovoid*, *stylopodium obscure*, *style columnar*, *tapering*, *as long as ovary*. **Fruits:** pedicels *c.* 1 mm long; *calyx lobes subequal*, *ovate*, *to 0.6 × 0.5 cm*, *acute*, *saccate*, *appressed against the nut*. **Nuts** exposed above calyx towards apex, ovoid, to 0.8 × 0.5 cm, subacute.

Vernacular name. Sarawak—*luis kerangas* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah recorded from Bt. Tawai, Kinabatangan district (e.g., *SAN 39349*) and in Sarawak from Bau, Kuching, Lundu, and Simunjan districts (e.g., *S 2274*, *S 14926*, *S 15530*, *S 21299*, and *S 29030*). Also occurring in C Kalimantan (e.g., *bb. 14959* and *bb. 16033*).

Ecology. Locally abundant in mixed dipterocarp forest on leached clay-rich soils and in *kerangas* on podsols, at altitudes below 300 m. Endangered.

18. **Hopea latifolia** Symington

(Latin, *latus* = wide, *folius* = leaf; with broad leaves)

Gard. Bull. S. S. 10 (1939) 360, *op. cit.* (1943) 131; Ashton *op. cit.* (1964) 102, *op. cit.* (1968) 52, *op. cit.* (1982) 404; Anderson *op. cit.* (1980) 116; PROSEA *op. cit.* 249. **Type:** *Mohamad FMS 8149*, Peninsular Malaysia, Pahang, Kuantan, Telok Siseh (holotype KEP).

Main canopy tree, to 40 m tall, to 70 cm diameter, *with small thin buttresses and stilt roots*. **Bark** *smooth*; *inner bark pale brown or pink*. **Twigs** *c.* 1 mm diameter apically, slender, *glabrescent*. **Leaves** thinly coriaceous, drying pale brown including venation; *blade ovate*, 5–8 × 2.2–4.5 cm, *base cuneate*, *frequently subequal*, margin not revolute, apex caudate, acumen to 1.5 cm long; *midrib slender*, *terete*, *elevated on both surfaces*; *venation dryobalanoid*, *veins indistinct and hardly raised*, *drying not blackish*; *main lateral veins c. 8 pairs*; intercostal venation obscure, reticulate; *petiole 1.2–1.7 cm long*, slender, somewhat geniculate. **Inflorescences** axillary or rarely terminal, greyish caducous puberulent, to 4 cm long, singly or doubly branched, branchlets bearing to 5 distichous flowers. **Flowers:** buds small, ovoid; petals ovate, cream; stamens *c.* 15, anthers globose, connectival appendage as long as anther; *ovary ovoid*, *stylopodium obscure*, *style columnar*, villous towards base, as long as ovary. **Fruits** subsessile; *calyx lobes unequal*, *2 longer lobes spatulate*, to 6 × 1.4 cm, narrowly obtuse, *tapering to 3 mm above the saccate base*, *3 shorter ones ovate*, *acute*, *to 0.9 × 0.7 cm*, *hardly conceiling the nut*. **Nuts** *broadly ovoid*, *to 0.8 × 0.7 cm*, with *c.* 2 mm long filiform style remnant.

Vernacular name. Sarawak—*luis daun bulat* (preferred name).

Distribution. Peninsular Malaysia and Borneo. In Borneo known in Sabah from Labuk Sugut district (e.g., *SAN 90497*) and in Sarawak from Kuching, Serian and Tatau districts (e.g., *S 7614*, *S 9340*, *S 16631*, *S 44906*, and *S 64962*). Also occurring in Brunei (e.g., *BRUN 3179* and *BRUN 3338*) and E Kalimantan (e.g., *Kostermans 6752*).

Ecology. Locally common in mixed dipterocarp forest on leached sandy clay soils, on low hills at altitudes to 400 m. Well represented in Bako NP but elsewhere vulnerable.

Notes. For differences from *H. beccariana* see there.

19. **Hopea longirostrata** P.S.Ashton

(Latin, *longus* = long, *rostratus* = beaked; the tapering fruit base and long pedicel)

Gard. Bull. Sing. 22 (1967) 277, *op. cit.* (1968) 52, *op. cit.* (1982) 399; Anderson *op. cit.* (1980) 116. **Type:** *Ashton S 17742*, Borneo, Sarawak, Belaga district, Ulu Belaga (holotype K; isotypes KEP, L).

Subcanopy tree, to 14 m tall; buttresses thin, low. **Bark** *smooth*, *becoming patchily thinly flaky*; *inner bark pale brown*. *All parts glabrous.* **Twigs** *c.* 2 mm diameter apically. **Leaves** coriaceous, drying greyish brown; *blade ovate-elliptic*, 7–9 × 3–5 cm, base obtuse, *margin not revolute*, apex subcaudate, acumen to 1.5 cm long; *midrib* slender but prominent above, *sharply elevated below*, *tending to dry black*; *venation dryobalanoid*, unraised and more or less obscure, arched; *main lateral veins c. 12 pairs*, with subequal intermediates; petiole 0.7–1 cm long, slender, geniculate, drying black. **Flowers** unknown. **Infructescences** terminal or in axillary clusters of 3, to 4 cm long, singly branched, branchlets bearing to 5 secund fruits. **Fruits:** base tapering; *pedicels to 7 mm long*; *calyx lobes unequal*, *2 longer lobes spatulate*, *to 2.4 × 0.6 cm*, *tapering to 3 mm and ending abruptly in a small incrassate central tubercle*, *3 shorter ones linear to spatulate*, *to 1.5 cm long*, *similar at base*, *conceiling the nut*. **Nuts** ovoid, to 0.6 × 0.4 cm, with to 2 mm long slender style remnant.

Distribution. Endemic in Borneo and confined to Ulu Tubau, Bintulu district and Ulu Belaga, Belaga district in Sarawak (e.g., *S 18191* and the type).

Ecology. Rare and endangered, in small groups in mixed dipterocarp forest on clay-rich soils, at *c.* 300 m altitude.

20. **Hopea megacarpa** P.S.Ashton

(Greek, *mega* = huge, *karpos* = fruit; the large nut)

Gard. Bull. Sing. 22 (1967) 278, *op. cit.* (1968) 53, *op. cit.* (1982) 426; Anderson *op. cit.* (1980) 116. **Type:** *Daud & Tachun SFN 35625*, Borneo, Sarawak, Kapit district, Nanga Pelagus (holotype K; isotype KEP).

Subcanopy tree, to 15 m tall, to 20 cm diameter. **Bark** *smooth*; *inner bark yellowish brown. Young twig*, *petiole and venation below sparsely caducous puberulent*; *leaf bud persistently so*; *parts otherwise glabrous.* **Twigs** *c.* 1 mm diameter apically, slender, sparingly branched, dark brown. **Leaves** thinly coriaceous, undulate, drying pale brown; *blade narrowly ovate-lanceolate*, 6–12 × 1.5–5 cm, *base equal*, *cuneate*, apex caudate, acumen to 2 cm long, slender; *midrib* prominent and terete below, *flat to somewhat raised and slender above*; *venation hopea-type*; *lateral veins 6–7 pairs*, slender, raised below, ascending and arched; *domatia not prominently swollen*; intercostal venation densely scalariform, slender and unraised; petiole *c.* 0.6 cm long, slender. **Inflorescences** axillary, lax, to 3 cm long, singly branched, *branchlets bearing to 3 dense flowers*; *bracts fugaceous*. **Flowers:** buds subglobose, to 4 × 3 mm; petals elliptic-oblong, pale pink; *stamens c. 15*, anthers oblong, connectival appendage *c.* 3x the length of anther; *ovary and stylopodium cylindrical*, *subtruncate*, *style short.* **Fruits:** pedicels *c.* 3 mm long, broadening into receptacle; calyx lobes unequal, 2 longer lobes narrowly spatulate, acute, to 10 × 1.3 cm, tapering to *c.* 5 mm above the subauriculate saccate base, 3 shorter ones ovate, to 2 × 0.9 cm, similarly subauriculate, conceiling the nut. **Nuts** ovoid, to 1.2 × 1 cm, with mucronate minutely truncate apex.

Distribution. Endemic in Borneo. Known in Sarawak only from Kapit district (e.g., *S 639*, *S 14743*, *S 29085*, *S 29490*, and *S 41546*). Also occurring in SE Kalimantan (e.g., *Suzuki K 9754*).

Ecology. Locally gregarious understorey trees of mixed dipterocarp forest on sandy clay soils, at altitudes below 500 m. Vulnerable, probably endangered.

21. **Hopea mengerawan** Miq.

(Sumatran vernacular name)

Fl. Ned. Ind., Suppl. (1862) 491; Ridley *op. cit.* (1922) 238; Foxworthy *op. cit.* 137; Symington *op. cit.* (1939) 361, *op. cit.* (1943) 132; Ashton *op. cit.* (1968) 53, *op. cit.* (1982) 400; Anderson *op. cit.* (1980) 116; PROSEA *op. cit.* 249; Kessler & Sidiyasa *op. cit.* 98; Newman *et al. op. cit.* 151. **Type:** *Teijsmann s.n.* (= *U sub. No. 035930*), Sumatra, Palembang, Muara Enim (holotype U; isotypes BO, L). **Synonym:** *Hancea mengerawan* (Miq.) Pierre *op. cit. t.* 243.

Large main canopy or low emergent tree, to 45 m tall, to 1 m diameter; crown hemispherical; buttresses to 5 cm thick, flying buttresses to 1.5 m tall; *stilt roots sometimes present*. **Bark** *becoming deeply narrowly v-section fissured*, *dark chocolate-brown and grey-mottled.* **Sapwood** honey-yellow, hard; heartwood dark brown. *Twig*, *petiole and leaf below caducous lepidote*; *parts of petal exposed in bud sericeous*; *parts otherwise glabrous.* **Twigs** *c.* 2 mm diameter apically. **Leaves** *coriaceous*, drying warm chocolate-brown below, golden-brown above; *blade* oblong-lanceolate, *6–12 × 2.5–5 cm*, *base cuneate*, apex with tapering acumen to 1.5 cm long; midrib stout, prominent on both surfaces; *venation dryobalanoid*, *veins evident but hardly elevated below*, *drying not blackish*; *main lateral veins c. 14 pairs*, with many short to subequal intermediates; *petiole 0.9–1.1 cm long*, *stout.* **Inflorescences** terminal or axillary, stout, to 3 cm long, singly branched, branchlets bearing to 6 secund flowers. **Flowers:** buds ovoid, to 3 × 2 mm; petals oblong-lanceolate, pale yellow; stamens *c.* 15, anthers subglobose, connectival appendage 2–3x the length of anther; *ovary ovoid*, *stylopodium obscure*, *style columnar*, villous in basal half, *c.* 2x the length of ovary. **Fruits:** pedicels *c.* 2 mm long; calyx lobes unequal, 2 longer lobes narrowly spatulate, narrowly obtuse, to 7 × 1.2 cm, tapering to *c.* 3 mm above the saccate base, *3* *shorter ones ovate, acute, to 0.6 × 0.5 cm, appressed to but not conceiling the nut apex.* **Nuts** narrowly ovoid, to 1 × 0.5 cm, with prominent terminal filiform style remnant.

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo. In Sabah recorded from Lahad Datu, Sandakan and Tawau districts (e.g., *SAN 16981*, *SAN 23267*, *SAN 32508*, and *SAN 39302*) and in Sarawak from Bintulu and Mukah districts (e.g., *S 15577* and *S 23247*). Also occurring in W, E and S Kalimantan (e.g., *bb. 24523*, *Kostermans 6657*, *Kostermans 6745*, *Kostermans 12513*, and *Sidiyasa 605*).

Ecology. In mixed dipterocarp forest near the base of low hills, on sandy soils often with impeded drainage, at altitudes below 200 m. Inexplicably rare and critically endangered throughout Borneo, with records based on few collections from isolated localities.

22. **Hopea mesuoides** P.S.Ashton

(Latin = resembling *Mesua*, Guttiferae)

Gard. Bull. Sing. 22 (1967) 279, *op. cit.* (1968) 54, *op. cit.* (1982) 413; Anderson *op. cit.* (1980) 116; Coode *et al.* (eds.) *op. cit.* 72. **Type:** *Ilias S 15551*, Borneo, Sarawak, Bintulu district, Segan FR (holotype K; isotypes KEP, L). **Synonym:** *Hopea subalata auct. non* Symington: Ashton *op. cit.* (1964) 110.

Subcanopy to low canopy tree, to 30 m tall, to 50 cm diameter, with persistently monopodial diffuse crown and pendent branches; buttresses thin and low, *flying buttresses and stilt roots present*. **Bark** *smooth*. *Leaf bud*, *flower parts exposed in bud and stipule pale yellowish brown puberulent*, *indumentum persistent except on calyx*; *other parts glabrous.* **Twigs** *c.* 1.5 cm diameter apically, slender, sparingly branched. **Leaves** *coriaceous*, *drying pale chocolate-brown below*, *yellowish brown above*; *blade ovate-lanceolate*, *8–14 × 2.5–5 cm*, base obtuse, equal, margin more or less narrowly revolute, apex caudate, acumen to 1.5 cm long; *midrib* slender but prominent below, *obscure and sunken above*; *venation subdryobalanoid*; main lateral veins *c.* 11 pairs, slender and distinctly raised below, arched, with short intermediates; *intercostal venation evident below*, *reticulate*; *petiole 0.7–1 cm long*, *slender.* **Inflorescences** axillary, slender, to 4 cm long, lax, singly branched; *bracts c. 1 mm long*, *subpersistent*. **Flowers:** buds small, ovoid; petals oblong, dark red; stamens *c.* 15, anthers subglobose, connectival appendage 2–3x the length of anther; *ovary and stylopodium cylindrical*, *truncate*, papillose at apex, style short. **Fruits:** pedicels *c.* 1 mm long; base impressed; *calyx lobes subequal*, *ovate*, *chartaceous*, *erose near the subacute apex*, *to 1.4 × 1.2 cm*, *appressed to the nut*. **Nuts** subglobose, apex protruding above calyx, crowned by persistent truncate stylopodium.

Distribution. Endemic in Borneo. Recorded in Sarawak from Bintulu, Limbang, Marudi, Miri, and Tatau districts (e.g., *S 11247*, *S 25058*, *S 27123*, *S 31839*, and *S 32314*) and in Brunei from Amo, Belait and Tutong districts (e.g., *BRUN 879*, *BRUN 5674* and *FMS 34451*).

Ecology. In mixed dipterocarp forest on yellow sandy clay soil and *kerangas* forest on podsols, on low hillslopes, at altitudes to 200 m. Locally abundant, forming dense groups with abundant juveniles. Vulnerable owing to its accessable habitat.

23. **Hopea micrantha** Hook.*f.*

(Greek, *mikro-* = small, *anthos* = a flower; with small flowers)

Trans. Linn. Soc. 23 (1860) 161; Merrill *op. cit.* (1921) 402; Symington *op. cit.* (1939) 355; Masamune *op. cit.* 490; Browne *op. cit.* 121, *p.p.*; Ashton *op. cit.* (1964) 103, *op. cit.* (1968) 54, *op. cit.* (1982) 401; Meijer & Wood *op. cit.* 213; Burgess *op. cit.* 129; Anderson *op. cit.* (1980) 116; Coode *et al.* (eds.) *op. cit.* 72. **Lectotype** (Symington, 1939)**:** *Motley 215*, Borneo, Labuan (hololectotype K). **Synonym:** *Hancea micrantha* (Hook.*f.*) Pierre *op. cit. t.* 243.

Canopy tree, to 30 m tall, to 30 cm diameter, rarely to 40 m tall, to 80 cm diameter; buttresses small, narrow; *stilt roots many*. **Bark** *smooth*; *inner bark pale brown or pink. Young parts*, *leaf blade excepted*, *pale brown fugaceous puberulent.* **Twigs** *c.* 1 mm diameter apically, slender. **Leaves** thinly coriaceous, drying reddish brown below with the midrib darker, greyish brown above; *blade oblong-lanceolate*, 6–8 × 2.5–3 cm, *base equal*, *obtuse*, apex caudate, acumen to 1.5 cm long; *midrib evident*, *slightly raised above*, *terete and prominent below*, *not drying black*; *venation dryobalanoid*, hardly raised below; *main lateral veins c. 14 pairs*, with shorter intermediates, arched; petiole 0.7–1 cm long, slender. **Inflorescences** terminal or axillary, to 1 cm long, singly branched, branchlets bearing to 5 secund flowers. **Flowers:** buds small, ovoid; petals linear, pale pink; stamens *c.* 15, anthers broadly oblong, connectival appendage *c.* 1½x the length of anther; *ovary ovoid*, *stylopodium obscure*, *style columnar*, *c. 1½x the length of ovary.* **Fruits** subsessile; calyx lobes unequal, 2 longer lobes spatulate, obtuse, to 5 × 1.2 cm, tapering to 2 mm above the saccate base, *3 shorter ones broadly ovate to suborbicular*, *subacute or obtuse*, *to 0.5 × 0.5 cm*, *shorter than the nut*. **Nuts** ovoid, to 1 × 0.6 cm, with slender style remnant to 1.5 mm long.

Vernacular names. Sabah—*selangan lunas* (preferred name). Sarawak—*luis kerangas* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Sipitang district (e.g., *SAN 16264*), formerly also in Labuan (e.g., the type); and in Sarawak from Bintulu, Limbang, and Marudi districts (e.g., *S 951*, *S 1113*, *S 8267*, and *S 15893*). Also occurring in Brunei (e.g., *BRUN 512*, *BRUN 5526* and *Kirkup DK 748*).

Ecology. Very local, but there common, in *kerangas* forest on podsols, at altitudes below 100 m. Critically endangered.

24. **Hopea montana** Symington

(Latin, *montanus* = growing on mountains; the natural habitat)

J. Mal. Br. Roy. As. Soc. 19, 2 (1941) 141, *op. cit.* (1943) 133; Meijer & Wood *op. cit.* 214; Burgess *op. cit.* 129, 136; Ashton *op. cit.* (1982) 413; PROSEA *op. cit.* 250. **Type:** *Symington FMS 32257*, Peninsular Malaysia, Perak, G. Korbu (holotype KEP).

Subcanopy or canopy tree, to 35 m tall, to 1 m diameter; bole often crooked; buttresses thin, *flying buttresses and stilt roots present*. **Bark** *smooth or patchily cracked. Parts entirely glabrous.* **Twigs** *c.* 1 mm diameter apically, slender, blackish. **Leaves** thinly coriaceous, drying pale chocolate-brown; *blade ovate-lanceolate*, *6.5–9 × 2.2–4 cm*, base equal, abruptly cuneate, apex cuspidate, acumen to 1 cm long; *midrib obscure*, *sunken above*, slender but raised below as also the veins; *venation subdryobalanoid*; main lateral veins *c.* 14 pairs, with many short intermediates; *intercostal venation obscure*; petiole 0.9–1.1 cm long, slender. **Inflorescences** terminal or axillary, to 2 cm long, lax, slender, hardly branched, *with small deltoid subpersistent bracts*. **Flowers** (mature) unknown. **Fruits:** pedicels *c.* 2 mm long, expanding into receptacle; *calyx lobes unequal*, *2 longer lobes spatulate*, subacute, to 5 × 1.2 cm, tapering to 2 mm above the saccate thickened base, 3 shorter ones ovate to lanceolate, to 1 × 0.3 cm, conceiling the nut. **Nuts** ovoid, to 0.7 × 0.5 cm, with minutely truncate apex bearing a central apiculus.

Vernacular name. Sabah—*selangan bukit* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, recorded in Sabah from Kota Belud, Sipitang and Tambunan districts (e.g., *KEP 80317*, *SAN 16280*, *SAN 17002*, and *SAN 40258*).

Ecology. Rare but locally frequent in upper dipterocarp forest on hillslopes on clay-rich soils, at 900–1200 m altitude. Probably vulnerable as the habitat is mostly outside the National Park boundary.

25. **Hopea nervosa** King

(Latin, *nervosus* = bearing nerves; the many prominent leaf lateral veins)

J. As. Soc. Beng. 62, 2 (1893) 124; Ridley *op. cit.* (1922) 236; Foxworthy *op. cit.* 129; Symington *op. cit.* (1943) 185; Ashton *op. cit.* (1964) 104, *op. cit.* (1968) 54, *op. cit.* (1982) 410; Meijer & Wood *op. cit.* 215; Burgess *op. cit.* 129; Anderson *op. cit.* (1980) 116; PROSEA *op. cit.* 250; Coode *et al*. (eds.) *op. cit.* 72. **Type:** *King's Collector 3690*, Peninsular Malaysia, Perak, Larut (holotype CAL; isotype K).

Medium-sized subcanopy or low canopy tree, to 30 m tall, to 1 m diameter; buttresses thin, flying buttresses to 2 m tall; stilt roots present. **Bark** *smooth*, greyish brown. **Sapwood** pale, soft. *Young parts including midrib throughout caducously greyish puberulent.* **Twigs** *c.* 1 mm diameter apically, slender, sparsely branched. **Leaves** thinly coriaceous, *drying warm chocolate-brown below*; *blade narrowly ovate to lanceolate*, 9–18 × 4–7 cm, *base equal*, *broadly cuneate*, apex with tapering acumen to 1.4 cm long; midrib slender but prominent and terete below, narrowly sunken above; *venation hopea-type*; *lateral veins 13–15 pairs*, slender but prominent below; intercostal venation very slender, dense, sinuate-scalariform, unraised; petiole 1–1.2 cm long. **Inflorescences** terminal or in axillary pairs, lax, to 9 cm long, singly branched, *branchlets bearing to 5 remote flowers*; *bracts deltoid*, *subpersistent*. **Flowers:** buds subglobose, to 3 mm diameter; petals narrowly oblong, purplish with paler tips; stamens *c.* 15, anthers subglobose, connectival appendage *c.* 2x the length of anther; *ovary and stylopodium broadly cylindrical*, *truncate*, *style short*. **Fruits** subsessile; *calyx lobes unequal*, *2 longer lobes spatulate*, to 12 × 1.8 cm, narrowly obtuse, thinly coriaceous, strongly twisted, tapering to 3 mm above the saccate base, 3 shorter ones lanceolate, acute, to 1.5 cm long, more or less conceiling the nut. **Nuts** broadly ovoid, to 1 × 1 cm, with apiculate minutely truncate apex.

Vernacular names. Sabah—*selangan jangkang* (preferred name). Sarawak—*luis jangkang* (preferred name).

Distribution. Peninsular Malaysia and Borneo. In Borneo recorded in Sabah from Kinabatangan and Sandakan districts (e.g., *FMS 35404*, *SAN 23305*, *SAN 34254*, *SAN 38954*, and *SAN 39016*) and in Sarawak from Belaga, Kapit, Lundu, and Tatau districts (e.g., *S 14380*, *S 25010*, *S 29072*, *S 43557*, and *S 50182*). Also occurring in Brunei (e.g., *BRUN 790*, *FMS 35671* and *Wong WKM 1922*) and E Kalimantan (e.g., *Kostermans 4109*, *Kostermans 4342*, *Kostermans 4394*, and *Kostermans 13981*). Particularly common in W Sarawak and E Sabah, elsewhere scattered.

Ecology. In mixed dipterocarp forest, locally common on well-structured deep clay soils on slopes and low hills on intermediate and basic igneous rocks, more scattered on sedimentaries, at altitudes to 400 m. Occurring in G. Gading and Mulu NPs; elsewhere vulnerable owing to forest conversion.

26. **Hopea nutans** Ridl.

(Latin, *nutans* = nodding; the flowers)

FMP 1 (1922) 235; Foxworthy *op. cit.* 123; Symington *op. cit.* (1943) 136; Browne *op. cit.* 125; Ashton *op. cit.* (1964) 104, *op. cit.* (1968) 54, *op. cit.* (1982) 424; Meijer & Wood *op. cit.* 217; Burgess *op. cit.* 135; Anderson *op. cit.* (1980) 117; PROSEA *op. cit.* 263; Coode *et al.* (eds.) *op. cit.* 72; Newman *et al. op. cit.* 153. **Lectotype** (designated here)**:** *Henbrey KEP 417*, Peninsular Malaysia, Pahang, Kuantan (hololectotype K; isolectotype KEP).

Canopy tree, to 40 m tall, to 1.2 m diameter; crown diffuse-irregular; bole often misshapen; buttresses low. **Bark** *greyish brown*, *becoming coarsely irregularly flaky*; *dammar exudations not conspicuous*. **Sapwood** yellowish brown; heartwood warm brown, hard. *Young parts*, *leaf blade excepted*, *sparsely pale brown puberulent*; *leaf blade below more or less sparsely greyish lepidote.* **Twigs** to 2 mm diameter apically, relatively stout, much-branched. **Leaves** *thickly coriaceous*, drying greyish; *blade broadly ovate*, 8–13 × 4.5–8.5 cm, *base obtuse*, *subequal*, margin more or less revolute, apex broadly tapering, with acumen to 1 cm long; midrib stout, somewhat raised on both surfaces; *venation hopea-type*; *lateral veins 7–10 pairs*, relatively stout, somewhat raised below, arched, *usually with a few large glabrous swollen pore-like domatia*; intercostal venation slender but distinct, subscalariform; petiole 1–1.5 cm long, fairly stout. **Inflorescences** terminal or axillary, to 7 cm long, *branchlets bearing to 5 secund dense flowers*; *bracts fugaceous*. **Flowers:** buds broadly ellipsoid, to 4 × 2 mm; petals linear, cream; *stamens c. 15*, anthers subglobose, connectival appendage *c.* 2x the length of anther, scabrous towards apex; *ovary and stylopodium subcylindrical*, *style short.* **Fruits:** subsessile; calyx lobes unequal, 2 longer lobes oblong, broad, obtuse, thinly coriaceous, to 8 × 1.5 cm, tapering to 2.5 cm above the saccate base, 3 shorter ones ovate, acute, to 1 cm long. **Nuts** ovoid to 1.5 × 0.8 cm, acute.

Vernacular name. Sabah and Sarawak—*giam* (preferred name).

Distribution. Peninsular Malaysia and Borneo. In Sabah known from Lahad Datu and Semporna districts (e.g., *FMS 44588* and *SAN 26123*) and in Sarawak from Kuching and Lundu districts (e.g., *S 6311*, *S 10120*, *S 10255*, *S 49868*, and *S 57896*). Also occurring in Brunei (e.g., *S 1668*, *S 1953* and *S 5801*) and NE Kalimantan.

Ecology. Local, uncommon in coastal hill mixed dipterocarp forest on sandy soils, frequently with impeded drainage, ultrabasic soil and limestone outcrops. Occurring in Bako and Mulu NPs but endangered elsewhere.

27. **Hopea obscurinerva** P.S.Ashton

(Latin, *obscurus* = indistinct, *nervus* = nerve; the indistinct venation on the leaf undersurface)

TFSS 5 (2004) 479. **Type:** *Mohtar S 51417*, Borneo, Sarawak, Bintulu district, Ulu Tubau (holotype KEP; isotype SAR).

Small subcanopy tree, to 10 m tall, *c.* 15 cm diameter, with low thin buttresses. **Bark** *smooth*. *All parts glabrous.* **Twigs** *c.* 2 mm diameter apically, sparsely branched, warm brown, somewhat shiny. **Stipules** linear, to 3 mm long, not at first caducous. **Leaves** *thickly coriaceous*, *not bullate*, *drying warm pinkish brown below*, yellowish brown and somewhat shiny above; *blade oblong-lanceolate*, *15–26 × 5–8 cm*, *base markedly unequal*, *obtuse to subcordate*, apex with slender acumen to 1.5 cm long; *midrib prominent above*, *less so below*; *venation hopea-type*; *lateral veins 11–14 pairs*, with a few intermediates, ascending, arched, *prominently raised above*, *hardly elevated below*; intercostal venation obscure, densely scalariform; petiole 0.4–0.6 cm long, *c.* 0.3 cm diameter, stout, drying black. **Inflorescences** and **flowers** unknown. **Fruits** (young)**:** pedicels 1–2 mm long; *base of fruit impressed*; *calyx lobes unequal*, *2 longer lobes narrowly spatulate*, at least 4 × 0.8 cm, *not auriculate*, 3 shorter ones narrowly deltoid, to 1.2 × 0.5 cm. **Nuts** ovoid, glabrous, surmounted by a *c.* 3 mm long, spindle-shaped stylopodium remnant.

Distribution. Endemic in Borneo and known to date only from the lower Tubau drainage in Sarawak (e.g., *S 18195* and the type).

Ecology. In mixed dipterocarp forest on clay soil, at *c.* 300 m altitude. Endangered.

28. **Hopea ovoidea** P.S.Ashton

(Latin, *ovoideus* = egg-shaped; the ovary)

Gard. Bull. Sing. 31 (1978) 34, *op. cit.* (1982) 426. **Type:** *Elmer 21428*, Borneo, Sabah, Tawau district (holotype K; isotype L).

Canopy tree, to 1 m diameter; buttresses prominent, thin. **Bark** *flaky*, *brown*. **Sapwood** hard. *Leaf bud*, *inflorescence*, *and parts of flower exposed in bud densely persistently pale buff-pubescent*; *parts otherwise glabrescent.* **Twigs** *c.* 1 mm diameter apically, slender. **Leaves** *chartaceous and undulate*, *drying pale greyish brown*; *blade elliptic to narrowly ovate*, *9–13 × 3–6.5 cm*, *base unequal or subequal*, *cuneate*, shortly decurrent, apex with slender, tapering acumen to 2 cm long; midrib slender but distinctly raised on both surfaces; *venation hopea-type*; *lateral veins 7–8*(*–10*) *pairs*, *slender but distinctly elevated below*, *arched*, *often with a few glabrous pore-like canaliculate domatia*; intercostal venation scalariform, distinctly elevated below; petiole 1–1.5 cm long, slender. **Inflorescences** in axillary pairs or terminal, pendent, to 13 cm long, singly branched, lax, *branchlets bearing to 7 secund flowers*; *bracts fugaceous*. **Flowers:** buds ovoid, to 3 × 2 mm; petals lanceolate, cream; *stamens c. 15*, anthers narrowly elliptic, connectival appendage 1½–2x the length of anther; *ovary and stylopodium ovoid*, *tomentose*, *style c. ½x the length of ovary*, *glabrous.* **Fruits** unknown.

Distribution. Endemic in Borneo; known only from Lahad Datu, Sandakan and Tawau districts in Sabah (e.g., *SAN 21690*, *SAN A 2489* and *SAN A 4829*).

Ecology. Rare and endangered (possibly extinct), in mixed dipterocarp forest on low coastal hills.

29. **Hopea pachycarpa** (F.Heim) Symington Fig. 15.

(Greek, *pachy-* = thick, *karpos* = fruit; the large and thick fruit)

Gard. Bull. S. S. 8 (1934) 30; Masamune *op. cit.* 491; Browne *op. cit.* 125; Ashton *op. cit.* (1964) 105, *op. cit.* (1967) 271, *op. cit.* (1968) 54, *op. cit.* (1978) 35, *op. cit.* (1982) 432; Anderson *op. cit.* (1980) 117; Coode *et al.* (eds.) *op. cit.* 72. **Basionym:** *Pierrea pachycarpa* F.Heim *op. cit.* (1891) 958. **Type:** *Beccari PB 3314*, Borneo, Sarawak, Marop (holotype P). **Synonyms:** *Balanocarpus pubescens* Ridl. *op. cit.* (1922) 247; *Hopea laxa* Symington *op. cit.* (1934) 33; *H. resinosa* Symington, Gard. Bull. S. S. 8 (1935) 278.

Subcanopy tree, to 40 m tall, to 80 cm diameter, with pendent leaves and twigs; crown dark, irregular; buttresses low, thin; stilt roots present. **Bark** *smooth*. *Young twig*, *leaf bud*, *stipules outside*, *foliar domatia*, *and petiole densely persistently pale fawn-pubescent or whitish-pruinose or silvery lepidote*; *inflorescence fugaceously so*; *floral sepals fimbriate*; *parts otherwise glabrous*. **Twigs** *c.* 2 mm apically, sparingly branched. **Leaves** thinly coriaceous, *drying greyish green*, *more or less silvery lepidote below*; *blade flat*, *elliptic to lanceolate*, *13–22 × 4–7 cm*, *base unequal*, *cuneate to obtuse*, margin often narrowly revolute, apex with a slender acumen to 1 cm long; *midrib stout*, *terete*, *raised on both surfaces*; *venation hopea-type*; *lateral veins* (*10–*)*13–17 pairs*, *slender but raised below*, *flat above*, arched and running concurrently up margin, with small tomentose axillary domatia; intercostal venation slender, densely scalariform, sinuate; petiole 0.7–1 cm long, stout. **Inflorescences** *in axillary pairs or ramiflorous*, rarely branched. **Flowers:** buds broadly ellipsoid, to 4 × 2.5 mm; petals cream; stamens *c.* 15, anthers subglobose, connectival appendage 2–3x the length of anther; *ovary small*, *ovoid*, *style and stylopodium spindle-shaped*, glandular-papillose towards tapering apex. **Fruits** large, impressed at base; *calyx lobes subequal*, *ovate*, *subacute*, *to 2 × 1.5 cm*, thickened, saccate, appressed to the nut. **Nuts** ovoid-globose, to 1.5 cm diameter, acute, conceiled in calyx except for the apex, usually resin-coated.

Vernacular name. Sarawak—*merkoyong* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo recorded in Sabah from Keningau and Pensiangan districts (e.g., *SAN 128204*, *SAN 136792*, *SAN 139662*, and *SAN 139667*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lawas, Lundu, Miri, Serian, Simunjan, Sri Aman, and Tatau districts (e.g., *S 13572*, *S 15408*, *S 22406*, *S 36881*, *S 43206*, and *S 43834*). Also occurring in Brunei (e.g., *BRUN 168*, *BRUN 3345* and *BRUN 5647*) and Kalimantan (e.g., *Burley & Tukirin 762*, *Hansen 1374* and *Kessler et al. Berau 19*).

Ecology. Locally abundant in mixed dipterocarp forest on moist lower slopes and streamsides, on clay-rich soils, on both sedimentary and intermediate and basic igneous rocks, at altitudes below 400 m. Occurring in G. Gading and Mulu NPs but vulnerable elsewhere.

30. **Hopea pedicellata** (Brandis) Symington

(Latin, *pedicellatus* = with prominent stalk; the flowers)

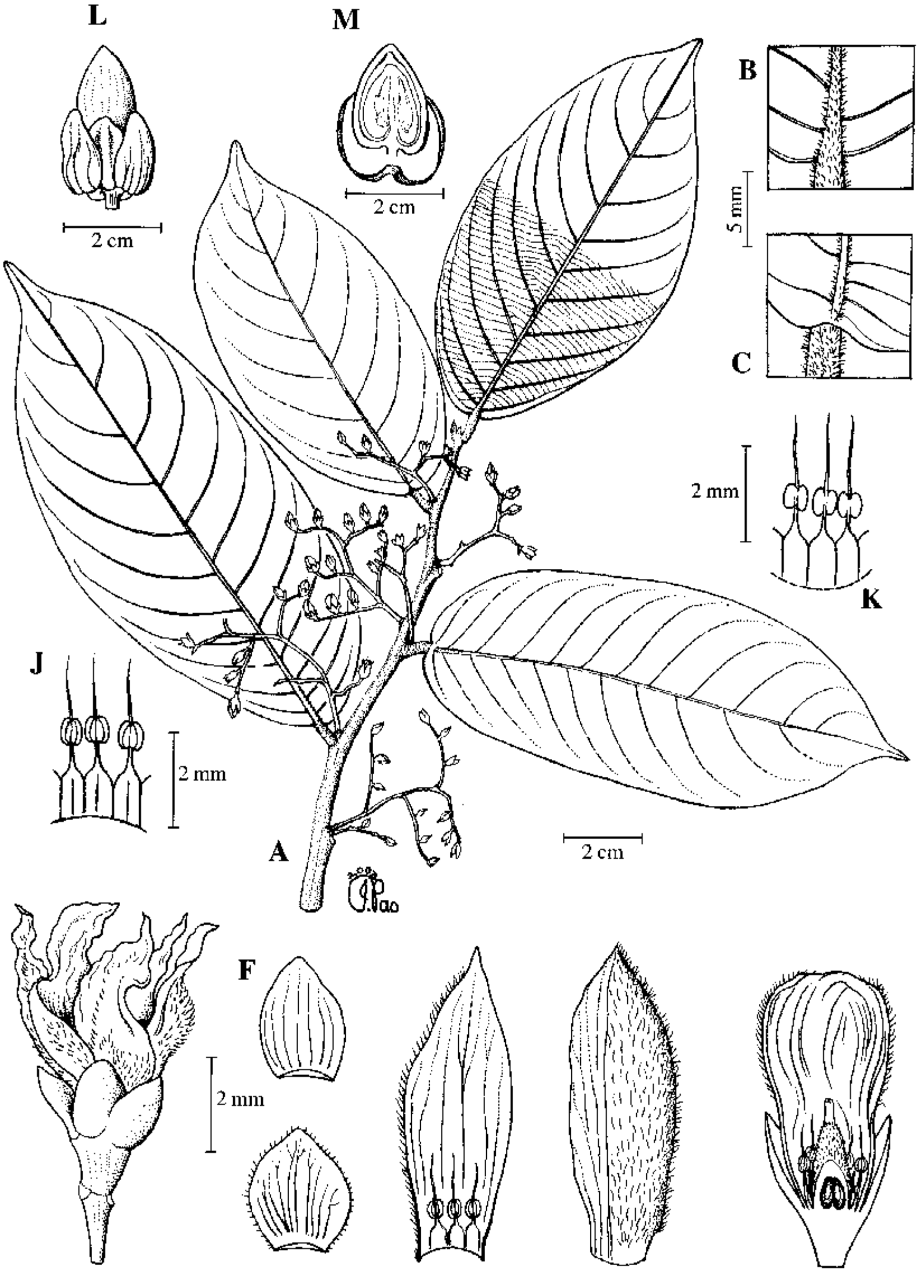

Fig. 15. *Hopea pachycarpa.* A, flowering leafy twig; B, detail of indumentum on lower leaf surface; C, detail of indumentum on upper leaf surface; D, open flower; E, longitudinal section of opening flower; F, adaxial view of outer sepal; G, adaxial view of inner sepal; H, adaxial view petal with stamens; I, abaxial view of petal; J, adaxial view of stamens; K, abaxial view of stamens; L, fruit; M, longitudinal section of fruit. (A–K from *S 21300*, L–M from *S 36881*.)

Gard. Bull. S. S. 9 (1938) 327, *op. cit.* (1943) 138; Ashton *op. cit.* (1968) 54, *op. cit.* (1978) 30, *op. cit.* (1982) 408; Anderson *op. cit.* (1980) 117; PROSEA *op. cit.* 252; Coode *et al.* (eds.) *op. cit.* 72. **Basionym:** *Hopea griffithii* Kurz var. *pedicellata* Brandis, J. Linn. Soc. Bot. 31 (1895) 69, *p.p.* **Lectotype** (Ashton, 1978)**:** *Curtis 167*, Peninsular Malaysia, Penang (hololectotype K). **Synonym:** *Hopea siamensis* F.Heim, Bot. Tidsskr. 25 (1902) 46.

Small canopy tree, to 40 m tall, to 60 cm diameter; bole often crooked; buttresses low, thin; *stilt roots present*. **Bark** *dark brown*, *smooth*, *hoop-marked or sometimes patchily cracked*; *inner bark pinkish brown*; dammar exudations glassy. *Young twig and inflorescence caducously*, *petiole*, *leaf bud*, *stipules and domatia persistently greyish brown puberulent.* **Twigs** *c.* 1 mm diameter apically, slender, much-branched. **Leaves** *thinly coriaceous to coriaceous*; *blade flat*, *ovate-lanceolate*, *4–9 × 1–3.5 cm*, base cuneate, *margin flat*, *apex subcaudate*, *acumen to 1.5 cm long*; *midrib slender but raised on both surfaces or sharp below and tending to dry black*; *venation dryobalanoid*, hardly elevated, indistinct; *main lateral veins c. 8–12*(*–15*) *pairs*, *not drying black*, with many subequal intermediates, *obscure below*; petiole 0.6–0.8 cm long. **Inflorescences** terminal or axillary, to 4 cm long, singly branched, branchlets bearing to 7 secund flowers. **Flowers:** buds ovoid, to 2.5 × 2 mm; petals oblong-lanceolate, pale yellow; *stamens c. 15*, anthers oblong, connectival appendage *c.* 2x the length of anther; *ovary and stylopodium cylindric-conical*, *attenuate*, *truncate*, punctate in the distal half, *style short.* **Fruits:** pedicels 2 mm long; calyx lobes unequal, 2 longer lobes spatulate, to 3 × 0.5 cm, tapering to 2 mm above the saccate base, 3 shorter ones ovate, to 0.3 × 0.3 cm, appressed to the nut. **Nuts** ovoid, to 0.6 × 0.4 cm, abruptly acute, exceeding calyx.

Vernacular name. Sarawak—*mata kucing bukit* (preferred name).

Distribution. Peninsular Thailand, Peninsular Malaysia and Borneo. In Sabah recorded from Kota Belud district (e.g., *SAN 76269*, young buds, tentative) and in Sarawak from Belaga, Bintulu, Miri, Serian, Simunjan, and Tatau districts (e.g., *S 15213*, *S 17023*, *S 18351*, *S 25017*, and *S 64525*). Also occurring in Nunukan Is. in Kalimantan.

Ecology. Uncommon and scattered in distant localities in mixed dipterocarp forest on undulating land and ridges, at altitudes to 600 m. Vulnerable.

31. **Hopea pentanervia** Symington *ex* Wood

(Greek, *penta-* = five, *nervius* = nerved; the leaf blade)

Gard. Bull. Sing. 17 (1960) 495; Browne *op. cit.* 126, Anderson, Gard. Bull. Sing. 20 (1963) 157, *op. cit.* (1980) 117; Ashton *op. cit.* (1964) 106, *op. cit.* (1968) 55, *op. cit.* (1982) 425; Meijer & Wood *op. cit.* 219, Burgess *op. cit.* 135; PROSEA *op. cit.* 263, Coode *et al.* (eds.) *op. cit.* 72, Newman *et al. op. cit.* 154. **Type:** *Tready S 1257*, Borneo, Sarawak, Miri district, Baram (holotype KEP; isotype SAR).

Canopy tree, to 35 m tall, to 1 m diameter; crown irregular, with large twisted branches; buttresses to 1 m tall, *c.* 4 cm thick. **Bark** *vertically cracked and oblong-flaked*, warm dark brown and grey-mottled. **Sapwood** straw yellow, hard; heartwood chocolate-brown. *Young parts puberulent*; *all parts glabrescent but for the fimbriate flower sepals and pubescent parts of petals exposed in bud.* **Leaves** coriaceous, drying yellowish brown; *blade ovate*, 5–10 × 3.2–5 cm, *base equal*, *obtuse or broadly cuneate*, margin somewhat revolute, apex with slender, tapering acumen to 1.5 cm long; midrib slender, raised below, flat above; *venation hopea-type*; *lateral veins c. 5 pairs*, slender but prominent below, arched, *with small glabrous pore-like domatia*; intercostal venation densely scalariform, evident; petiole

0.6–1.1 cm long. **Inflorescences** terminal or in axillary pairs, lax, to 8 cm long, singly branched, *branchlets bearing to 6 dense secund flowers*; *bracts fugaceous*. **Flowers:** buds ellipsoid, *c.* 1.5 mm long; petals lanceolate, cream; *stamens c. 15*, anthers subglobose, connectival appendage *c.* 3x the length of anther; *ovary and stylopodium cylindrical*, *truncate*, *style short.* **Fruits** subsessile; calyx lobes unequal, 2 longer lobes spatulate, obtuse, chartaceous, to 5 × 1.2 cm, tapering to 3 mm above the saccate base, 3 shorter ones ovate, acute, appressed to the nut. **Nuts** ovoid, to 0.4 × 0.35 cm, acute.

Vernacular names. Sabah—*selangan lima urat* (preferred name). Sarawak—*cengal paya* (preferred name).

Distribution. Endemic in Borneo, occurring throughout SW and E Sabah and recorded from Beaufort, Keningau, Kinabatangan, Labuk Sugut, Papar, Sandakan, and Sipitang districts (e.g., *SAN 25467*, *SAN 38766*, *SAN 96930*, *SAN 130223*, and *SAN 138822*) and in Sarawak from Betong, Bintulu, Kuching, Lawas, Limbang, Marudi, Miri, and Sibu districts (e.g., *S 260*, *S 1530*, *S 18387*, *S 23288*, and *S 24651*). Also occurring in Brunei (e.g., *BRUN 5007*, *Coode 7649* and *FMS 35467*).

Ecology. Locally frequent on shallow peat, usually over sand, in mixed peat swamp forest and the ecotone of *kerangas*, and in *kerangas* on podsols on terraces and low hills, at altitudes to 400 m; on ultrabasic rocks in E Sabah; usually near the coast. Occurring in Mulu NP, elsewhere endangered.

32. **Hopea plagata** (Blanco) Vidal

(Latin, *plagata*, wounded; the wound-like domatia)

Synopsis (1883) *t.*15A; Merrill, Spec. Blancoan. (1918) 2691; Ashton *op. cit.* (1978) 32, *op. cit.* (1982) 423, PROSEA *op. cit.* 264; Newman *et al. op. cit.* 155. **Basionym:** *Mocanera plagata* Blanco, Fl. Filip. ed. 1 (1837) 447. **Neotype** (designated here)**:** *Merrill Sp. Blancoan. 109* (= *US 903784*), the Philippines, Luzon, Rizal Province, Langhaya (K, US). **Synonyms:** *Dipterocarpus plagatus* (Blanco) Blanco, Fl. Filip. ed. 2 (1845) 311; *Anisoptera plagata* (Blanco) Blume, Mus. Bot. Lugd. Bat. 2 (1852) 42; *Hopea dasyrrhachis auct. non* Slooten: Ashton *op. cit.* (1968) 49.

Large canopy tree, to 35 m tall, to 1 m diameter; crown irregular; buttresses to *c.* 1 m tall, thin. **Bark** *becoming dark greyish brown flaky*. **Sapwood** hard, yellow; heartwood brown. *Parts entirely glabrous*. **Twigs** *c.* 1 mm diameter apically, much-branched, dark brown. **Leaves** coriaceous, sometimes sparsely stellate-lepidote below, drying dark greyish brown; *blade elliptic-lanceolate to ovate-falcate*, *6–12 × 2.5–7 cm*, *base markedly unequal*, cuneate to obtuse, apex with tapering acumen to 1.5 cm long; midrib stoutly prominent on both surfaces; *venation hopea-type*; *lateral veins 8–11*(*–12*) *pairs*, slender but elevated below, *usually with glabrous pore-like domatia*; intercostal venation densely scalariform, hardly elevated; petiole 0.6–1.6 cm long. **Inflorescences** solitary, axillary or terminal, to 3 cm long, singly branched, *branches bearing to 6 dense secund flowers*; *bracts fugaceous*. **Flowers:** buds ellipsoid, to 3 × 2 mm; petals lanceolate, cream; *stamens c. 35*, anthers elongate, tapering, connectival appendage equal in length to anther, acicular; *ovary ovoid*, *stylopodium obscure*, *style short*, *broad.* **Fruits:** pedicels *c.* 2 mm long; calyx lobes unequal, 2 longer lobes broadly oblong-spatulate to suborbicular, to 4.5 × 2 cm, tapering to 3 mm above the saccate base, 3 shorter ones ovate, to 0.7 × 0.4 cm, shorter than the nut. **Nuts** narrowly ovoid, to 1 × 0.7 cm, acute.

Distribution. Borneo and the Philippines. In Sabah recorded from Kinabatangan, Kota Kinabalu, Lahad Datu, Sandakan, Semporna, Tawau, and Tenom districts (e.g., *KEP 80469*, *SAN 9414*, *SAN 15042*, *SAN 20178*, and *SAN 43093*) and in Sarawak from Marudi district (e.g., *BRUN 3203*, *S 22568*, *S 24037* and *S 30767*).

Ecology. Scattered in mixed dipterocarp forest, apparantly mostly on coastal hills in Sabah; also very local on humic soils over limestone, at low altitudes and in lower montane forest at 900–1100 m altitude. Well represented in Mulu NP but vulnerable in Sabah.

33. **Hopea pterygota** P.S.Ashton Fig. 16.

(Greek, *pterygotos* = winged; the fruit)

Gard. Bull. Sing. 22 (1967) 280, *op. cit.* (1968) 55, *op. cit.* (1982) 434; Anderson *op. cit.* (1980) 117; Coode *et al*. (eds.) *op. cit.* 73. **Type:** *Smythies S 15206*, Borneo, Sarawak, Simunjan district, G. Gaharu (holotype K; isotypes KEP, L).

Small monopodial hardly buttressed tree, to 10 m tall, to 10 cm diameter, with pendent twigs and leaves. **Bark** *smooth*, soft, whitish. *Young vegetative parts densely pale tawny pubescent*; *indumentum caducous on leaf below*, *petiole and twig*, *persistent on buds*, *stipules and also parts of petal exposed in bud*; *reproductive parts otherwise glabrous.* **Twigs** *c.* 2 mm diameter apically, sparingly branched. **Leaves** thinly coriaceous, *drying reddish brown below*; *blade flat*, *oblong-lanceolate to oblanceolate*, *12–28 × 5–9 cm*, *base markedly unequal*, *obtuse to subcordate*, apex subcaudate, acumen to 2 cm long; *midrib prominent on both surfaces*, *more so below*; *venation hopea-type*; *lateral veins 12–21 pairs*, *slender*, *prominent below*, *sunken above*, *dense*; intercostal venation scalariform, not dense, slightly elevated; petiole 0.3–0.8 cm long, stout. **Inflorescences** *in axillary clusters of 4 or ramiflorous*, slender, lax, singly branched, branches bearing to 8 secund flowers. **Flowers:** buds ellipsoid, to 3 × 2 mm; petals linear; stamens *c.* 15, anthers subglobose, connectival appendage very slender, 3–4x the length of anther; *ovary narrowly ovoid*, *stylopodium and style spindle-shaped*, somewhat shorter than ovary. **Fruits:** pedicels *c.* 1 mm long; *calyx lobes unequal*, *2 longer lobes spatulate*, to 10 × 1.5 cm, chartaceous, *tapering to c. 4 mm then expanding to 7 mm wide paired auricles at the saccate base*, 3 shorter ones lanceolate-deltoid, acute, to 1.2 cm long, similarly auriculate. **Nuts** ovoid, to 0.7 × 0.5 cm, acute, conceiled within auricles.

Distribution. Endemic in Borneo; found throughout Sarawak and recorded from Belaga, Kapit, Marudi, Miri, Mukah, Serian, Sibu, Song, Sri Aman, and Tatau districts (e.g., *S 23612*, *S 25022*, *S 29630*, *S 36567*, *S 57666*, and *S 64844*). Also occurring in Brunei.

Ecology. Locally gregarious, on a wide range of soils over acid and basic volcanic rocks, shale, and also white sand podsol terrace; on well-drained sites, in mixed dipterocarp forest, *kerangas*, and on ridges in the lower levels of upper dipterocarp forest, at 700–800 m altitude. Locally abundant in Lambir and Mulu NPs; not yet vulnerable.

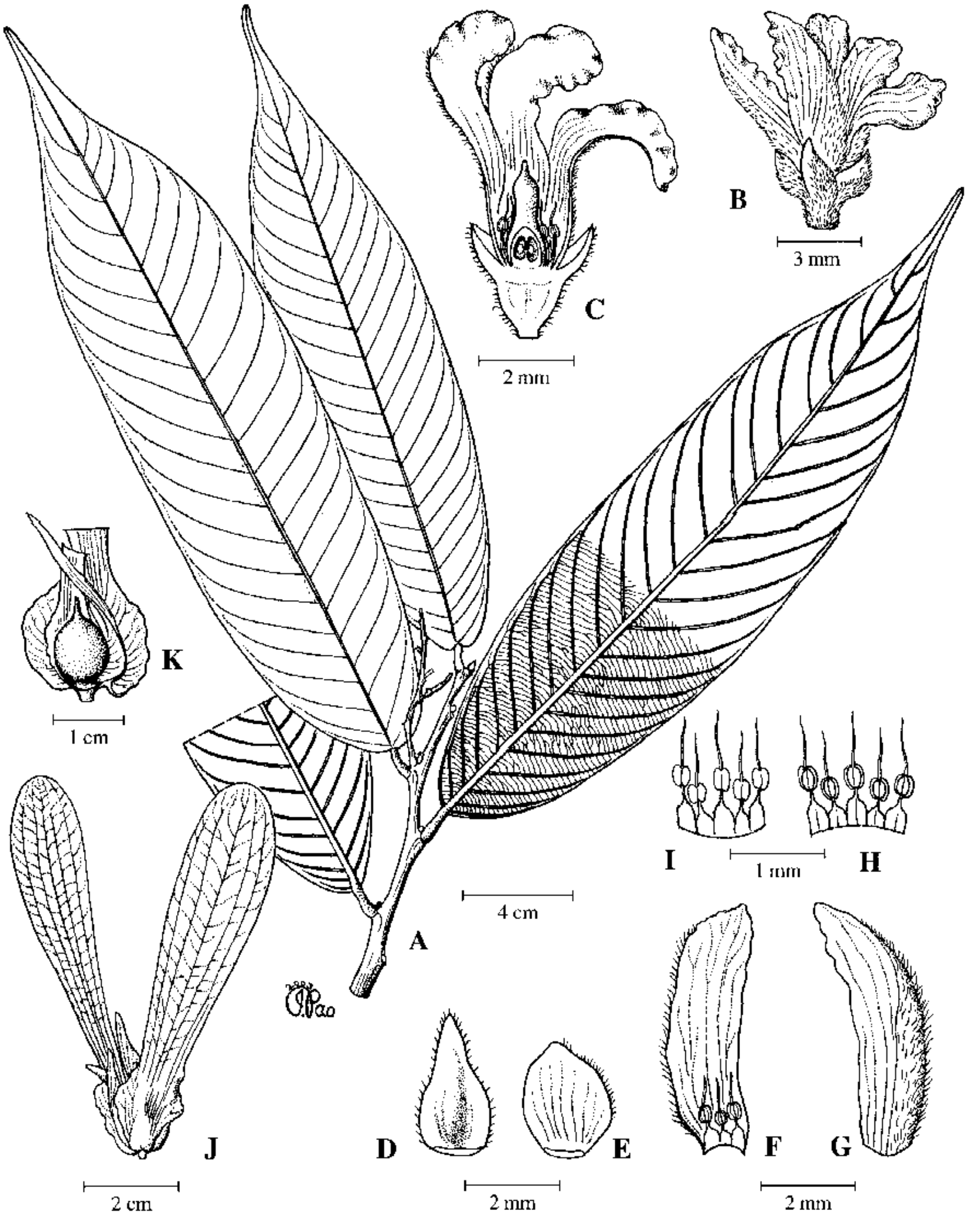

Fig. 16. *Hopea pterygota.* A, fruiting leafy twig; B, open flower; C, longitudinal section of open flower; D, adaxial view of outer sepal; E, adaxial view of inner sepal; F, adaxial view of petal with stamens; G, abaxial view of petal; H, adaxial view of stamens; I, abaxial view of stamens; J, fruit; K, exposed nut. (A and J–K from *S 29630*, B–I from *S 66783*.)

34. **Hopea rudiformis** P.S.Ashton Fig. 17.

(Latin, *rudis* = the gladiatorial sword, *formis* = shape; the leaf shape)

Gard. Bull. Sing. 31 (1978) 30, *op. cit.* (1982) 409; Kessler & Sidiyasa *op. cit.* 99. **Type:** *Kostermans 4394*, Borneo, Kalimantan, Balikpapan, Sg. Wain (holotype L; isotypes BO, K).

Subcanopy to low canopy tree, to 35 m tall, to 40 cm diameter; crown more or less persistently monopodial; buttresses to 1 m tall, thin; flying buttresses and stilt roots present. **Bark** greyish, *smooth*. **Sapwood** pale, soft. *Fleshy exposed parts pale tawny puberulent*; *indumentum persistent on young twigs*, *buds and petals*; *sparse on inflorescence*; *caducous on leaf venation below and calyx.* **Twigs** *c.* 2 mm diameter apically, ribbed, sparingly branched. **Leaves** thinly coriaceous, *more or less sparsely greyish stellate-lepidote below thereby appearing dull*; *blade ovate to broadly lanceolate*, 6.5–14 × 3.5–7.5 cm, *base equal*, broadly cuneate, margin narrowly revolute, apex tapering, downcurved, acumen to 1.5 cm long; midrib and veins obscure and sunken above, slender but prominent below; *venation hopea-type*; *lateral veins 11–13 pairs*, arched; intercostal venation densely scalariform, obscure; petiole 0.8–1.3 cm long. **Inflorescences** in axillary pairs, to 3.5 cm long, singly branched, *branchlets bearing to 3 remote flowers*; *bracts subpersistent*. **Flowers:** buds ovoid, to 3 × 2 mm; petals oblong, deep purplish red; stamens *c.* 15, anthers broadly oblong, connectival appendage slightly longer than anther; *ovary ovoid*, *surmounted by indistinct tapering stylopodium and short columnar style.* **Fruits:** pedicels to 2 mm long; *calyx lobes unequal*, *2 longer lobes broadly spatulate*, to 9 × 2 cm obtuse, tapering to 3 mm broad above the saccate base, 3 shorter ones ovate, to 0.8 × 0.8 cm, subacute, appressed to nut and enclosing it. **Nuts** ovoid-globose, to 0.8 × 0.8 cm, terminating in a minutely truncate stylopodium remnant.

Vernacular name. Sabah—*selangan jangkang* (Dusun).

Distribution. Endemic in Borneo. In Sabah, recorded from Kinabatangan, Labuk Sugut, Lahad Datu, Sandakan, Tenom, and Tawau districts (e.g., *SAN 18563*, *SAN 25471*, *SAN 29672*, *SAN 53121*, and *SAN 124401*). Also known in E Kalimantan (e.g., *bb. 25152*, *Kostermans 4109*, *Kostermans 4549*, and *Kostermans 13981*).

Ecology. In lowland forest on undulating land on clay-rich soil, sometimes in freshwater swamps, at altitudes to 500 m; locally common. Vulnerable owing to forest conversion.

35. **Hopea rugifolia** P.S.Ashton

(Latin, *rugosus* = wrinkled, *folius* = leaf; the wrinkled dried leaf)

Gard. Bull. Sing. 54, 2 (2002) 213. **Type:** *Wong WKM 1414*, Borneo, Brunei, Temburong district, Bt. Belalong south ridge (holotype K; isotype BRUN). **Synonym:** *Hopea sphaerocarpa auct. non* (F.Heim) P.S.Ashton: Coode *et al*. (eds.) *op. cit.* 73.

Small monopodial understorey tree, to 20 m tall, to 20 cm diameter, with low buttresses and *stilt roots*. **Bark** *smooth*. *Young parts densely evenly minutely greyish brown puberulent*; *indumentum persisting sparsely on leaf venation below*, *midrib above at base*, *and petiole*; *elsewhere glabrescent.* **Leaves** *chartaceous*, *drying greyish brown and wrinkled*; *blade broadly lanceolate*, *5–9 × 2–3.5 cm*, *base broadly cuneate*, apex with slender acumen to 1.5 cm long; *midrib slender but elevated below*, *obscure and sunken above*; *venation subdryobalanoid*; main lateral veins *c.* 10 pairs, slender but sharply raised below; *intercostal*

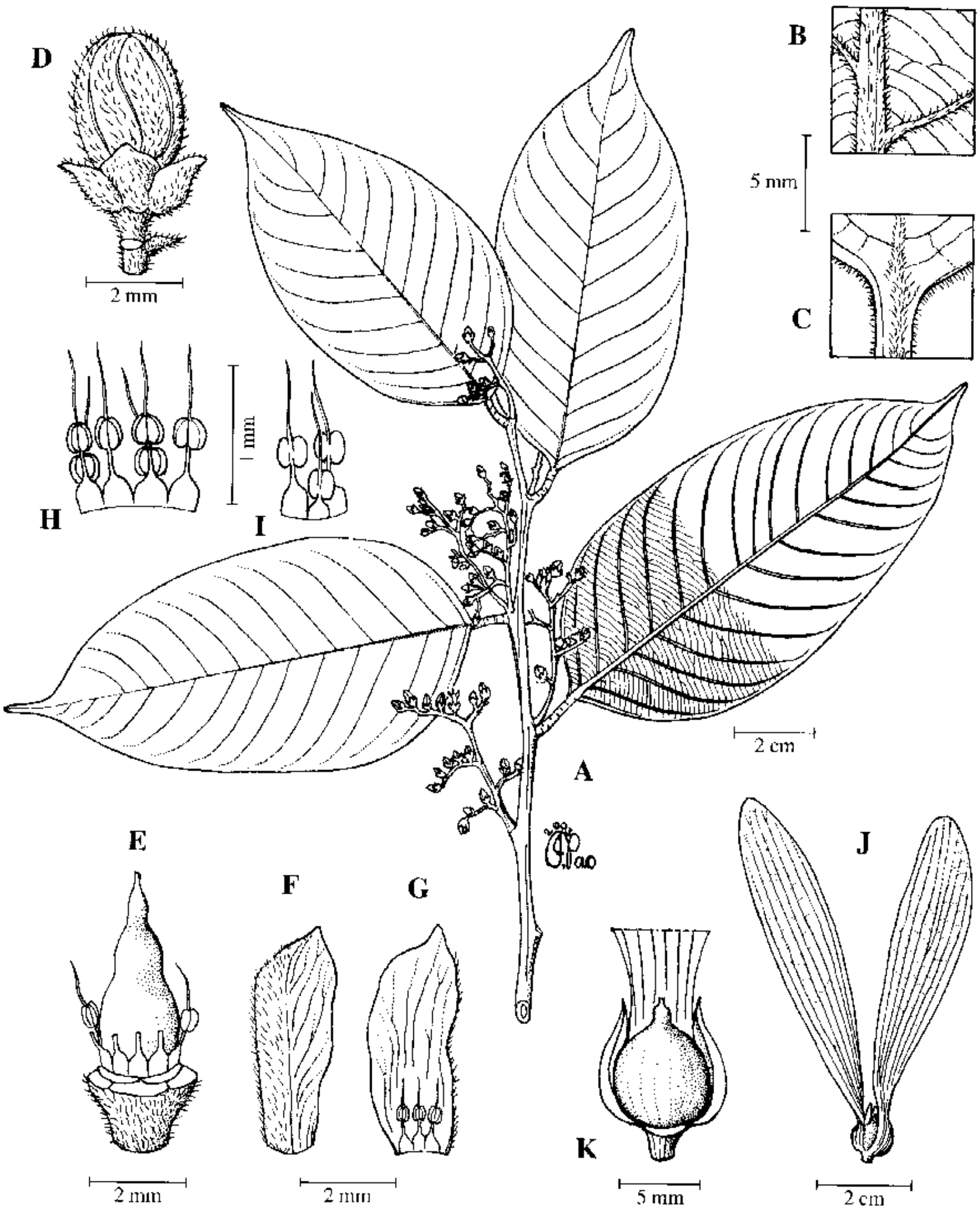

Fig. 17. *Hopea rudiformis*. A, flowering leafy twig; B, detail of indumentum on lower leaf surface; C, detail of indumentum on upper leaf surface; D, flower bud; E, gynoecium; F, abaxial view of petal; G, adaxial view of petal with stamens; H, adaxial view of stamens; I, abaxial view of stamens; J, fruit; K, exposed nut. (A–I from *FMS 38775*, J–K from *S 73781*.)

venation densely scalariform, *evident below*; *petiole to 0.4 cm long*, *slender*. **Inflorescences** in axillary pairs, slender, lax, to 4 cm long, singly branched, *branchlets bearing to 6 remote distichous flowers*; *bracts deltoid*, *to 1 mm long*, *subpersistent*. **Flowers:** buds broadly ovoid, to 2 × 1.5 mm; petals oblong, purple; stamens *c*. 15, anther ellipsoid, connectival appendage *c*. 2x the length of anther; *ovary and stylopodium narrowly cylindrical*, *truncate*, *medially constricted*, style short conical. **Fruits:** pedicels to 5 mm long, slender; *calyx lobes subequal*, *ovate*, *to 0.8 × 0.7 cm*, acute, appressed to nut. **Nuts** broadly ovoid, to 1 × 0.8 cm, with to 2 mm prominent stylopodium remnant.

Distribution. Endemic in Borneo; so far known only from Miri (Lambir NP) and Tatau (Bt. Mersing) districts in Sarawak (e.g., *S 25028* and *S 46439*), and Temburong district in Brunei (e.g., the type).

Ecology. In mixed dipterocarp and upper dipterocarp forest on friable fertile clay soils, at 100–800 m altitude. Well represented in Lambir NP but vulnerable elsewhere.

36. **Hopea sangal** Korth.

(from Dayak name in Kalimantan)

Kruidk. (1841) 75; Symington *op. cit.* (1934) 18, *op. cit.* (1943) 141; Keith *op. cit.* 41; Masamune *op. cit.* 491; Browne *op. cit.* 121; Ashton *op. cit.* (1963) 260, *op. cit.* (1964) 108, *op. cit.* (1968) 56, *op. cit.* (1982) 420, Meijer & Wood *op. cit.* 222; Burgess *op. cit.* 129; Anderson *op. cit.* (1980) 117; PROSEA *op. cit.* 253; Coode *et al.* (eds.) *op. cit.* 73; Newman *et al. op. cit.* 156. **Type:** *Korthals s.n.* (= *RHL Sheet No. 933193*), Borneo (holotype L; isotypes BO, U). **Synonyms:** *Dryobalanops sericea* Korth. *op. cit.* 72; *Hopea sericea* (Korth.) Blume *op. cit.* (1852) 35; *Petalandra micrantha* Hassk., Hort. Bog. Desc. (1852) 105; *H. fagifolia* Miq. *op. cit.* 490; *Doona micrantha* (Hassk.) Burck *op. cit.* 233; *Doona javanica* Burck *op. cit.* 235; *H. hasskarliana* F.Heim, Rech. Dipt. (1892) 64; *H. javanica* (Burck) F.Heim *op. cit.* (1892) 64; *H. curtisii* King *op. cit.* 124; *H. globosa* Brandis *op. cit.* 61; *H. lowii* Dyer *ex* Brandis *op. cit.* 63; *H. minutiflora* C.E.C. Fischer, Bull. Misc. Inform. Kew (1927) 207.

Medium-sized canopy tree, to 40 m tall, to 1.3 m diameter; bole often misshapen; buttresses low, thin. **Bark** *vertically cracked and scaly*, *becoming conspicuous dark brown with contrasting cream-white opaque dammar coxcombs*. **Sapwood** pale, soft. *Inflorescence*, *parts of perianth exposed in bud and domatia densely whitish buff-puberulent*; *indumentum persistent on inflorescence and domatia*; *parts otherwise glabrous*. **Twigs** *c*. 1 mm diameter apically, slender, much-branched. **Leaves** chartaceous, drying wrinkled, dull sooty greyish brown; *blade ovate*, 5.5–10 × 3.5–5 cm, *base equal*, broadly cuneate, apex caudate, acumen to 1.2 cm long; midrib flat, evident above, slender and prominent below; *venation hopea-type*; *lateral veins 10–12 pairs*, slender but prominent below, *often with small pale pubescent domatia*; intercostal venation densely scalariform, indistinct; petiole 0.5–1 cm long, slender. **Inflorescences** terminal or axillary, lax, to 7 cm long, singly or doubly branched, *branchlets bearing to 7 dense secund flowers*; *bracts fugaceous*. **Flowers:** buds ellipsoid-ovoid, to 2 × 1.5 mm; petals oblong-lanceolate, cream; *stamens c. 10*, anthers oblong, connectival appendage as long as anther; *ovary and stylopodium shortly broadly cylindrical*, *truncate*, more or less puberulent, style *c*. 2/3x the length of ovary and stylopodium. **Fruits:** pedicels *c*. 1 mm long; calyx lobes unequal, 2 longer lobes oblong-spatulate, obtuse, to 7 × 1.5 cm, tapering to 4 mm above the saccate base, 3 shorter ones ovate, obtuse, to 0.5 × 0.4 cm, shorter than the nut. **Nuts** ovoid, to 0.7 × 0.4 cm, with minutely subtruncate apiculate apex, often sparsely puberulent.

Vernacular name. Sabah and Sarawak—*gagil* (preferred name).

Distribution. Myanmar, Peninsular Thailand, Sumatra, Peninsular Malaysia, Java, Bali, and Borneo. Widespread throughout Sabah and recorded from Kinabatangan, Kudat (including Banggi Is.), Labuk Sugut, Lahad Datu, Ranau, Sandakan, Semporna, Tawau, and Tenom districts (e.g., *SAN 15417*, *SAN 17904*, *SAN 21690*, *SAN 37573*, and *SAN 74317*) and in Sarawak from Bau, Belaga, Bintulu, Kuching, Lundu and Tatau districts (e.g., *S 922*, *S 13190*, *S 18440*, *S 43527*, and *S 49872*). Also occurring in Brunei (e.g., *BRUN 3378*, *FMS 30544* and *FMS 39619*) and Kalimantan (e.g., *bb. 34337* and *Endert 2117*).

Ecology. Scattered in mixed dipterocarp forest on friable fertile clay-rich soils, on intermediate and basic igneous rocks and also shales and clays, at altitudes to 500 m. Vulnerable though occurring in G. Gading and Mulu NPs.

37. **Hopea semicuneata** Symington

(Latin, *semi-* = half, *cuneatus* = wedge-shaped; the leaf base)

Gard. Bull. S. S. 8 (1934) 24, *op. cit.* (1943) 143; Masamune *op. cit.* 491; Meijer & Wood *op. cit.* 224; Burgess *op. cit.* 135; Ashton *op. cit.* (1968) 56, *op. cit.* (1982) 426; Anderson *op. cit.* (1980) 117; PROSEA *op. cit.* 264; Newman *et al. op. cit.* 157. **Type:** *Awang FMS 4526*, Peninsular Malaysia, Pahang, Temerloh (holotype KEP). **Synonym:** *Hopea diversifolia* Miq., *op. cit.* 451, *p.p.*

Large canopy or low emergent tree, to 50 m tall, to 2 m diameter; bole tall, frequently misshapen; crown diffuse, small, hemispherical; buttresses to 7 m tall, 5 m long, *c.* 10 cm thick. **Bark** *becoming vertically cracked and oblong-flaked*, *fawn-brown*, *with opaque white dammar coxcombs*; inner bark pinkish brown. **Sapwood** straw yellow, hard; heartwood dark brown. *Inflorescences and parts of flower exposed in bud densely pale buff-pubescent*; *indumentum caducous on calyx*, *otherwise persistent*; *young twigs and petioles fugaceous puberulent*; *parts otherwise glabrous*. **Twigs** *c.* 1 mm diameter apically. **Leaves** *chartaceous*, *frequently undulate*, *drying greyish brown below*, purplish brown above, curling up; *blade elliptic to ovate-lanceolate*, 6.5–14 × 2–7 cm, *base narrowly or broadly cuneate*, *subequal*, apex tapering, acumen slender, to 2.5 cm long; midrib prominent, stout below, evident but hardly raised or somewhat sunken above; *venation hopea-type*; *lateral veins 6–9 pairs*, ascending, arched, *slender but prominent below*, narrowly sunken above, *often with prominent pustular domatia*; intercostal venation densely scalariform; petiole 0.6–1.2 cm long, slender. **Inflorescences** terminal or axillary, to 7 cm long, singly branched, *branchlets bearing to 7 dense secund flowers*; *bracts fugaceous*. **Flowers:** buds ellipsoid, to 2 × 1 mm; petals lanceolate, cream; *stamens c. 15*, anthers ellipsoid, connectival appendage *c.* 3x the length of anther; *ovary and stylopodium cylindrical*, *truncate*, *more or less medially constricted*, apical platform papillose, *style short*, *columnar*. **Fruits:** pedicels *c.* 2 mm long; calyx lobes unequal, 2 longer lobes broadly lorate, 9.5 × 2.2 cm, obtuse, tapering to *c.* 4 mm above the saccate base, 3 shorter ones broadly ovate, to 0.4 × 0.6 cm, subacute, shorter than the nut. **Nuts** subglobose, to 0.6 × 0.5 cm, shortly apiculate.

Vernacular name. Sabah—*selangan batu jantan* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, very local and generally uncommon. In Sabah recorded from Beaufort, Keningau, Kinabatangan, Kudat, Lahad Datu, Sandakan, and Tawau districts (e.g., *SAN 15205*, *SAN 16422*, *SAN 17718*, *SAN 36463*, and *SAN 96656*) and in Sarawak from Bintulu, Kapit and Lundu districts (e.g., *S 1815*, *S 9643* and *S 17722*).

Ecology. Uncommon in mixed dipterocarp forest, on clay-rich periodically flooded alluvium, at altitudes below 200 m. Endangered.

Notes. Material from Kudat, Lahad Datu and Sandakan districts differs in the smaller somewhat chartaceous leaf, wrinkling on drying but otherwise conforms with the species.

38. **Hopea sphaerocarpa** (F.Heim) P.S.Ashton

(Greek, *sphaero-* = round, *karpos* = fruit)

Gard. Bull. Sing. 20 (1963) 258, *op. cit.* (1968) 56, *op. cit.* (1982) 411; Anderson *op. cit.* (1980) 117. **Basionym:** *Balanocarpus sphaerocarpus* F.Heim *op. cit.* (1892) 77, Merrill *op. cit.* (1921) 407, Masamune *op. cit.* 483. **Type:** *Beccari PB 3021*, Borneo, 'Sarawak' (holotype P).

Small tree, to 10 m, to 10 cm diameter; crown remaining monopodial; with low, thin buttresses and *flying buttresses and stilt roots*. **Bark** *smooth*. *Young parts*, *including sometimes leaf venation but excluding inflorescence*, *tawny puberulent*; *indumentum caducous on calyx*, *more or less persistent elsewhere.* **Twigs** *c.* 0.5 mm diameter apically, slender, sparsely branched. **Leaves** *chartaceous*, *undulate*, *more or less flat*, *drying tawny brown below*, dark purplish above; *blade ovate to oblong-lanceolate*, *3.5–10 × 1.4–4.5 cm*, *base obtuse* to subcordate, apex with slender acumen to 1 cm long; *midrib slender*, *sunken above*, *elevated below*; *venation subdryobalanoid*; lateral veins 9–11 pairs, slender but elevated below, with short indistinct intermediates; *intercostal venation densely scalariform*, *slender but evident below*; *petiole 0.3–0.6 cm long*, *slender.* **Inflorescences** in axillary pairs or occasionally terminal, very slender, lax, to 10 cm long, singly branched, *branchlets zig-zag*, *bearing to 6 remote distichous flowers*; *bracts* linear, to 2 mm long, *subpersistent.* **Flowers:** buds subglobose, to 2 mm diameter; petals elliptic-oblong, dark crimson-red; stamens *c.* 15, anthers subglobose, connectival appendage 3–5x the length of anther; *ovary and stylopodium cylindrical*, *truncate*, *somewhat constricted medially*, *style short*, *narrowly conical.* **Fruits:** pedicels to 4 mm, long; *calyx lobes subequal*, ovate, to 0.8 × 0.7 cm, acute, appressed to the nut. **Nuts** broadly ovoid, to 1 × 0.8 cm, apex exposed with prominent truncate stylopodium remnant.

Distribution. Endemic in Borneo. In Sarawak recorded from Bau, Kuching, Lundu, and Sri Aman districts (e.g., *S 15004*, *S 29455*, *S 37849*, *S 49928*, and *S 68433*).

Ecology. Local, but often in dense populations; in mixed dipterocarp forest on leached sandy clay soils, at altitudes below 200 m. Critically endangered.

Notes. An apparently related entity has been collected in young fruit on G. Gading, Lundu district (*S 12601* and *S 15570*). In differs in its 12–15 pairs of steeply arching lateral veins. Confirmation of its status must await flowering material.

39. **Hopea tenuinervula** P.S.Ashton

(Latin, *tenuis*, slender, *nervulus*, a little nerve; the slender intercostal veins)

Gard. Bull. Sing. 22 (1967) 281, *op. cit.* (1968) 57, *op. cit.* (1982) 435; Anderson *op. cit.* (1980) 117; Coode *et al.* (eds.) *op. cit.* 73. **Type:** *Ariffin S 9616*, Borneo, Sarawak, Lundu district (holotype K; isotype KEP). **Synonym:** *Hopea philippinensis auct. non* Dyer: Ashton *op. cit.* (1964) 107.

Subcanopy tree, to 30 m tall, to 35 cm diameter; buttresses and stilt roots to 1 m tall, thin. **Bark** thinly powdery reddish brown mottled, *flaky*. *Young vegetative parts and perianth outside densely pale tawny puberulent*; *indumentum persistent on buds*, *stipules*, *petals*, *and somewhat so on veins and midrib on both surfaces*, *elsewhere caducous*. **Twigs** to 2 mm diameter apically, dark, sparingly branched. **Leaves** *thinly coriaceous*, *not bullate*, *drying dark chocolate-brown below*, paler above; *blade narrowly ovate to lanceolate*, *10–27 × 3–5.5 cm*, *base markedly unequal*, *obtuse*, margin narrowly revolute, apex with slender acumen to 1 cm long; midrib stout and raised on both surfaces; *venation hopea-type*; *lateral veins dense*, *12–21 pairs*, *slender but prominent below*, arched and running concurrent to margin before terminating; intercostal venation very slender and not elevated, densely sinuate-scalariform; petiole 0.3–0.7 cm long, stout. **Inflorescences** *in axillary pairs*, rarely terminal, lax, to 8 cm long, singly branched, branchlets bearing to 4 secund flowers; bracts deltoid, to 1 mm long, subpersistent. **Flowers:** buds ellipsoid, to 4 × 2 mm; petals oblong-lanceolate, pale yellow; stamens *c.* 15, anthers oblong-ellipsoid, connectival appendage *c.* 2x the length of anther; *ovary ovoid*, *stylopodium and style as long as ovary*, *hourglass-shaped*. **Fruits** subsessile; *calyx lobes unequal*, *2 longer lobes spatulate*, narrowly obtuse, to 10 × 1.7 cm, *tapering to 2 mm above the saccate base*, *not auriculate*, 3 shorter ones lanceolate, to 3 × 0.7 cm, slightly flanged along margin, conceiling the nut. **Nuts** ovoid, to 1.2 × 0.8 cm, shortly apiculate.

Vernacular names. Sabah—*selangan daun serong* (preferred name). Sarawak—*luis daun serong* (preferred name).

Distribution. Endemic in Borneo. In Sabah only known from Gaya Is., Kota Kinabalu district (e.g., *SAN 38708*, *SAN 46596* and *SAN 135353*) and in Sarawak from Kuching, Lundu and Sibu districts (e.g., *S 11091*, *S 12614*, *S 14812*, *S 25452*, and *S 37782*). Also occurring in Brunei (e.g., *BRUN 2624*, *BRUN 3290* and *S 1187*) and E and C Kalimantan (e.g., *bb. 17854* and *Ridsdale PBU 49*).

Ecology. Very local, but there often in dense populations, in mixed dipterocarp forest on leached sandy and sandy clay soils, at altitudes to 400 m. Endangered.

40. **Hopea treubii** F.Heim

(M. Treub, 1851–1910, sometime Director of the Bogor Botanic Gardens, Indonesia)

Bull. Mens. Soc. Linn. Paris 2 (1891) 955; Merrill *op. cit.* (1921) 403, Masamune *op. cit.* 492; Ashton *op. cit.* (1964) 111, *op. cit.* (1968) 57, *op. cit.* (1982) 406; PROSEA *op. cit.* 254; Coode *et al.* (eds.) *op. cit.* 73. **Type:** *Beccari PB 2895*, Borneo, Sarawak, Matang (holotype P).

Canopy tree, to 40 m tall, to 80 cm diameter, with irregular crown supported by a few large ascending twisted branches; buttresses and flying buttresses low. **Bark** *becoming densely v-section fissured*, *tawny brown*. **Sapwood** straw yellow, hard; heartwood dark warm brown. *Parts of petals exposed in bud pubescent*; *parts otherwise glabrous*. **Twigs** to 1.5 mm diameter apically. **Leaves** coriaceous, drying yellowish brown; *blade broadly elliptic to obovate*, *5–8 × 3–5.5 cm*, base cuneate, margin more or less revolute, *apex shortly broadly bluntly acuminate*; *midrib stout*, *somewhat raised on both surfaces*; *venation dryobalanoid*; main lateral veins elevated below, prominently arched, with long intermediates; petiole *c.* 1 cm long, rather stout. **Inflorescences** terminal or in axillary pairs or ramiflorous, rigid, slender, ascending, to 8 cm long, singly branched, branchlets bearing to 7 secund flowers. **Flowers:** buds ellipsoid, to 2.5 mm long, on prominent pedicels; petals narrowly lanceolate, lemon-yellow; *stamens c. 10*, anthers broadly oblong, connectival appendage *c.* 2x the length of anther; *ovary and stylopodium cylindrical*, *subtruncate*, papillose at apex, *style short.* **Fruits:** pedicels to 3 mm long, slender; calyx lobes unequal, 2 longer lobes spatulate, obtuse, to 3.5 × 0.7 cm, tapering to 2 mm wide above the saccate base, 3 shorter ones ovate, to 0.8 × 0.2 cm, appressed to but shorter than the nut. **Nuts** narrowly ovoid, to 1.1 × 0.5 cm, acute.

Vernacular name. Sarawak—*luis daun tebal* (preferred name).

Distribution. Endemic in Borneo. Known in Sarawak from Bau, Belaga, Kuching, Lundu, and Simunjan districts (e.g., *Chew CWL 1163*, *S 9482*, *S 10134*, *S 28979*, *S 43972*, and *S 68718*). Also occurring in Brunei (e.g., *BRUN 620*, *BRUN 3262*, *BRUN 3283*, *BRUN 5432*, and *Coode et al. MC 7103*).

Ecology. Scattered in mixed dipterocarp forest on leached yellow sands, on both sandstone and the Arip, Mukah, rhyolite, at altitudes to 400 m. Very local, highly vulnerable though frequent in Bako NP and recorded from Mulu NP.

41. **Hopea vaccinifolia** Ridl. *ex* P.S.Ashton

(Latin, *vaccinium* = the bilberry, *folius* = a leaf; the tiny *Vaccinium*-like leaves)

Gard. Bull. Sing. 19 (1962) 258, *op. cit.* (1964) 112, *op. cit.* (1968) 57, *op. cit.* (1982) 414; Anderson *op. cit.* (1980) 117; Coode *et al.* (eds.) *op. cit.* 73. **Type:** *Hose 583*, Borneo, Sarawak, Marudi district (holotype K).

Understorey monopodial tree, to 15 m tall, to 15 cm diameter, with flying buttresses and *stilt roots*. **Bark** *smooth*. *Young twig*, *leaf bud*, *stipules and petiole densely shortly persistently greyish brown puberulent*; *parts of petals exposed in bud sericeous*; *flower sepals fimbriate*; *other parts glabrous*. **Twigs** to 0.5 mm diameter apically, very slender, much horizontally branched, with persisting distichous leaf arrangement. **Leaves** chartaceous, drying greenish grey; *blade elliptic to broadly ovate*, *1–2.5 × 0.4–1.2 cm*, base equal; *midrib slender more or less slightly elevated below*, *obscure and sunken above*; *venation subdryobalanoid*; lateral veins 6 pairs, indistinct, hardly elevated, with short slender intermediates, arched; *intercostal venation reticulate*, *evident below*; *petiole to 0.2 cm long*, *slender*. **Inflorescences** in axillary pairs, slender, to 1.3 cm long, singly branched, *branchlets bearing to 3 remote flowers*; *bracts deltoid*, *to 1 mm long*, *subpersistent.* **Flowers:** buds subsessile; petals oblong, strongly contorted, rotate distally, dark red; *stamens c. 10*, anthers subglobose, connectival appendage *c.* 2x the length of anther; *ovary and stylopodium cylindrical*, *truncate*, puberulent on apical platform, style short. **Fruits:** *calyx lobes subequal*, *ovate*, *to 0.4 × 0.35 cm*, obtuse or acute, appressed round the base of the nut. **Nuts** ovoid, to 0.8 × 0.6 cm, minutely truncate.

Vernacular names. Sabah—*selangan* (preferred name). Sarawak—*luis ribu* (preferred name).

Distribution. Endemic in Borneo. Known in Sarawak from Marudi district (e.g., *BRUN 5664* and *S 33*). Also occurring in Brunei (e.g., *BRUN 140*, *BRUN 3035*, *FMS 30614*, and *FMS 35567*).

Ecology. Locally abundant, in dense clusters, on the giant podsols of the Pleistocene sea beach, in tall *kerangas* forest, at low altitudes. Critically endangered throughout its range.

42. **Hopea vesquei** F.Heim

(J. Vesque, 1848–1895, a Luxemburg botanist at the Paris Herbarium)

Bull. Mens. Soc. Linn. Paris 2 (1891) 971; Merrill *op. cit.* (1921) 403; Masamune *op. cit.* 492; Browne *op. cit.* 122; Ashton *op. cit.* (1968) 57, *op. cit.* (1982) 401; Anderson *op. cit.* (1980) 118; PROSEA *op. cit.* 254. **Type:** *Beccari PB 2550*, Borneo, 'Sarawak' (holotype P).

Subcanopy to low canopy tree, to 30 m tall, to 30 cm diameter; buttresses to 80 cm tall, thin; *stilt roots present*. **Bark** *becoming patchily cracked*; *inner bark pale brown or pink. Twigs*, *leaf bud*, *stipules*, *petiole*, *inflorescence*, *and parts of flower exposed in bud densely greyish brown puberulent*; *parts otherwise glabrous.* **Twigs** *c.* 1 mm diameter apically, much-branched. **Leaves** *thickly coriaceous*; *blade broadly ovate*, 3.5–6 × 1.5–3.5 cm, *base subobtuse*, *unequal*, apex with slender acumen to 1 cm long; *midrib stout*, *raised on both surfaces*, *not drying black*; *venation dryobalanoid*; *main lateral veins 10–13 pairs*, *slender*, *hardly elevated but distinct below*, with shorter intermediates, *basal pair short*; intercostal venation obscure, reticulate; petiole 0.6–0.7 cm long, slender. **Inflorescences** terminal or axillary, solitary, to 3 cm long, singly branched, branchlets bearing to 5 secund flowers. **Flowers:** buds ellipsoid, to 3 × 2 mm; petals lanceolate, pale cream-yellow; stamens *c.* 15, anthers subglobose, connectival appendage slightly longer than anther; *ovary ovoid*, *stylopodium obscure*, *style columnar*, *c. 1½x the length of ovary.* **Fruits:** pedicels to 2 mm long; *calyx lobes unequal*, *2 longer lobes spatulate*, obtuse, to 3.4 × 0.8 cm, tapering to *c.* 2 mm above the saccate base, *3 shorter ones ovate*, *acute*, *to 0.4 × 0.4 cm*, *clasping the base of the nut*. **Nuts** *cylindrical*, *to 1.5 × 0.3 cm*, tapering to *c.* 1 mm filiform style remnant.

Vernacular name. Sarawak—*luis tebal* (preferred name).

Distribution. Endemic in Borneo. Known only in W Sarawak from Kuching, Lundu and Miri districts (e.g., *S 3021*, *S 6363*, *S 9306*, *S 12498*, and *S 15171*).

Ecology. Local, but there common in mixed dipterocarp forest on usually shallow yellow sandy soil, at altitudes below 200 m. Locally common in Bako and Lambir NPs but elsewhere highly vulnerable.

Notes. Difficult to distinguish from *H. dyeri* without flowers or ripe fruit (*cf.* Meijer & Wood *op. cit.* 226).

43. **Hopea wyatt-smithii** Wood *ex* P.S.Ashton

(J. Wyatt-Smith, 1917–2002, former Silviculturist at the Forest Research Institute, Malaysia)

Gard. Bull. Sing. 19 (1962) 260, *op. cit.* (1964) 113, *op. cit.* (1968) 58, *op. cit.* (1982) 429; Meijer & Wood *op. cit.* 227; Burgess *op. cit.* 129; Anderson *op. cit.* (1980) 118; Coode *et al.* (eds.) *op. cit.* 73. **Type:** *G.H.S. Wood SAN 15061*, Borneo, Sabah, Beaufort district (holotype K; isotypes KEP, SAN).

Subcanopy tree, to 25 m tall, to 30 cm diameter, *with prominent flying buttresses and stilt roots*. **Bark** *smooth*; *inner bark plum-red. Parts glabrous but for sericeous parts of petals exposed in bud and stylopodium.* **Twigs** *c.* 1 mm diameter apically, slender, sparsely branched. **Leaves** thinly coriaceous, sparsely greyish lepidote below, drying greyish below, pale tawny-brown above; *blade broadly ovate to elliptic*, 9–14 × 5.5–9 cm, *base equal*, broadly cuneate or sometimes obtuse, apex caudate, acumen to 2 cm long; *midrib slender but evident and raised above*, *acutely elevated below*; *venation hopea- or subdryobalanoid-type*; *lateral veins 4–8 pairs*, with the main ones irregularly spaced owing to occasional prominent intermediates, slender, elevated below, arched but the basal 2–3 pairs at first decurrent with midrib, straight; intercostal venation evident but unraised, scalariform, lax; petiole 1.2–1.7 cm long, slender. **Inflorescences** *solitary*, terminal or axillary, to 6 cm long, singly branched, branchlets bearing to 6 secund flowers; bracts deltoid, to 1 mm long, not at first caducous. **Flowers:** buds subglobose, to 3 mm diameter; petals oblong-lanceolate, dark red; stamens *c.* 15, anthers broadly oblong, connectival appendage *c.* 2x the length of anther; *ovary and stylopodium hourglass-shaped*, tapering into short style. **Fruits** subsessile; calyx lobes subequal, ovate, subacute, to 1 × 0.8 cm, clasping the nut. **Nuts** broadly ovoid, to 1.2 × 1.2 cm, acute, the apical ¼ exposed.

Vernacular names. Sabah—*selangan daun bulat* (preferred name). Sarawak—*luis putih* (preferred name).

Distribution. Endemic in Borneo. Recorded in Sabah from Beaufort, Kinabatangan, Labuk Sugut, Lahad Datu, Sandakan, and Tawau districts (e.g., *SAN 16467*, *SAN 22634*, *SAN 28633*, and *SAN 44228*) and in Sarawak from Kapit, Limbang and Lubok Antu districts (e.g., *S 692*, *S 32275* and *S 32288*). Also occurring in Brunei (e.g., *BRUN 885*, *FMS 35475* and *S 5589*).

Ecology. In small groups of individuals, on clay-rich soils in mixed dipterocarp forest on moist slopes and low hills, at altitudes to 200 m. Rare and critically endangered by forest conversion.

6. **PARASHOREA** Kurz

(Greek, *para-* = similar to; resembling *Shorea*)

urat mata (preferred name)

J. As. Soc. Beng. 39, 2 (1870) 65; Slooten, Bull. Jard. Bot. Buitenz. 3, 8 (1927) 370; Symington, Malay. For. Rec. 16 (1943) 97; Masamune, EPB (1942) 492; Browne, FTSB (1955) 126; Ashton, MDB (1964) 82, MDBS (1968) 38, FM I, 9 (1982) 379; Meijer & Wood, Sabah For. Rec. 5 (1964) 190; Burgess, TBS (1966) 140; Anderson, CLTS (1980) 118; PROSEA 5, 1 (1993) 325; Newman *et al.*, MDFB-LHW (1996) 66.

Emergent trees, *with stout slightly concave hardly branched buttresses*; crown dense, hemispherical or dome-shaped, the leaves crowded towards the surface (except *P. macrophylla*). **Bark** *mauve-grey to purplish brown*, becoming narrowly shallowly fissured and flaky, *the fissures and buttress ridges densely whitish corky lenticellate*; inner bark fibrous, warm brown; dammar exudations opaque pale yellowish cream. **Sapwood** pale whitish to yellowish; heartwood pale to chocolate-brown. *Leaf buds often prominent*, *ovoid or falcate*. **Stipules** linear to hastate, falling early. **Leaves** *drying mauve-grey*, *undersurface* *greyish to silvery*, *persistently so in juveniles* (except *P. parvifolia* and *P. tomentella*); *juvenile leaves often peltate*; blade oblong-ovate, often asymmetric; midrib evident above; *lateral veins without intermediates*, *rather straight*, *not joining into intramarginal veins*, *dense with plicate folds remaining evident in the open leaf* (except *P. parvifolia*); *intercostal venation scalariform* (except *P. parvifolia*); petiole mostly weakly geniculate. **Inflorescences** *paniculate*, terminal or axillary. **Flowers:** *buds lanceolate*; *sepals narrow*, *hardly imbricate*; *petals falling separately*; stamens 15 in 3 whorls, *exceeding ovary in bud*, filaments short, dilated at base, abruptly tapering, *anthers with 4 pollen sacs*, *narrowly oblong*, *connectival appendage short or stout columnar*; *ovary small*, *ovoid*, pubescent, with or without stylopodium, *style long*, *filiform*. **Fruits:** pedicels short; *mature calyx lobes valvate*, *all long*, *spatulate*, *but unequal with 3 longer and broader than the other 2*, *pushed apart by the ripening nut.* **Nuts** *globose to ellipsoid*, *more or less pubescent and white corky lenticellate*; style caducous. Germination as in *Shorea* but *seedling leaves linear.*

Distribution. About 14 species; S Myanmar, Thailand, Indo-China and southernmost parts of China to Sumatra, Borneo and the Philippines. Six species occurring in Sabah and Sarawak; throughout but absent in Sarawak west of Sri Aman district.

Ecology. In mixed (and in Indo-Burmese seasonal wet evergreen) dipterocarp forest on clay soils, especially fertile and moist places, at altitudes to 1400 m. Usually scattered but some species in some areas locally abundant.

Uses. *Parashorea macrophylla*, *P. malaanonan* and *P. tomentella* are light hardwoods traded in Sabah as white *seraya*; the last two were among the most important export timbers from E Sabah, now largely exhausted. The other species are medium hardwoods. All are generally mixed with red meranti consignments.

Key to *Parashorea* species

1. Leaf blade at least 30 cm long; lateral veins at least 23 pairs; twigs flattened; crown large-leaved, long remaining monopodial……………………………**2. P. macrophylla**
Leaf blade at most 20 cm long; lateral veins at most 20 pairs; twigs round; crown dense, dome-shaped……………………………………………………………………………2

2. Mature leaf blade without visible folds between the at most 9 curved pairs of lateral veins, not silvery lepidote below……………………………………………**4. P. parvifolia**
Leaf blade with visible corrugations between the at least 9 pairs of straight lateral veins, more or less greyish silvery lepidote or tawny velutinous below……………………3

3. Midrib glabrous below; petiole glabrescent……………………………**3. P. malaanonan**
Midrib below and petiole tomentose or velutinous………………………………………4

4. Leaf undersurface persistently pale tawny velutinous…………………**6. P. tomentella**
Leaf undersurface more or less sparsely caducous yellowish brown scabrid-pubescent on the veins…………………………………………………………………………………5

5. Leaf lateral veins 9–12 pairs; petiole not geniculate……………………..…**1. P. lucida**
   Leaf lateral veins 8–10 pairs; petiole geniculate……………………..…**5. P. smythiesii**

1. **Parashorea lucida** (Miq.) Kurz

(Latin, *lucidus* = clear; the venation)

J. As. Soc. Beng. 39, 2 (1870) 66; Slooten *op. cit.* (1927) 372, *p.p*; Symington *op. cit.* (1943) 102; Ashton *op. cit.* (1968) 38, *op. cit.* (1982) 387; PROSEA *op. cit.* 331; Newman *et al. op. cit.* 70. **Basionym:** *Shorea lucida* Miq., Fl. Ned. Ind., Suppl. (1862) 487. **Lectotype** (designated here)**:** *Diepenhorst HB 2074*, Sumatra, Pariaman (hololectotype U). **Synonym:** *Shorea subpeltata* Miq., *op. cit.* 488.

Tree to 60 m tall, to 1.5 m diameter; *crown dense and dome-shaped. Young parts and leaf venation below more or less caducously greyish brown scabrid-pubescent*; *petiole*, *inflorescence*, *parts of flower exposed in bud, and ovary persistently so*. **Twigs** terete; stipule scars short, pale, horizontal. Leaf buds ovoid, to 4 × 2 mm. **Leaves** thinly coriaceous, *dull and more or less silvery stellate pubescent below*, *more or less persistently corrugated in between the lateral veins*; *blade* ovate-lanceolate to elliptic, *6–14 × 2.5–6.5 cm*, base unequal, broadly cuneate to subcordate, apex acuminate, acumen to 1 cm long; *lateral veins 9–12 pairs*, slender but prominent below, straight; intercostal venation slender but distinct below; *petiole* 1–2 cm long, tomentose, *not geniculate*. **Inflorescences** to 12 cm long, with secund flowers. **Flowers:** buds to 7 × 4 mm; connectival appendage acicular, prominent and longer than anthers. **Fruits:** calyx lobes to 8 × 1.7 cm. **Nuts** to 2.5 cm diameter.

Distribution. Sumatra and Borneo. In Borneo, known only in C and E Sarawak from Belaga, Bintulu, Kapit, and Sarikei districts (e.g., *S 18059*, *S 22238*, *S 22316*, *S 27990*, and *S 48164*).

Ecology. In Sarawak, local and uncommon and scattered in mixed dipterocarp forest on clay and sandy clay soils, at altitudes below 700 m. Vulnerable owing to land conversion.

2. **Parashorea macrophylla** Wyatt Smith *ex* P.S.Ashton

(Greek, *makros* = big, *phullon* = leaf; with large leaves)

Gard. Bull. Sing. 19 (1962) 262, *op. cit.* (1964) 83, *op. cit.* (1968) 38, *op. cit.* (1982) 382; Anderson *op. cit.* (1980) 118; PROSEA *op. cit.* 331; Newman *et al. op. cit.* 71; Coode *et al.* (eds.), CLBD (1996) 73. **Type:** *Ladi BRUN 2002*, Brunei, Kuala Belalong (holotype K; isotypes KEP, L).

Large tree, to 50 m tall, to 1 m diameter, *remaining monopodial into maturity*; *crown diffuse and adorned with the giant silvery leaves. Young parts*, *buds and inflorescence densely ochreous puberulent.* **Twigs** *c.* 12 × 5 mm apically, *compressed at first*; stipule scars amplexicaul. Leaf buds linear-falcate, to 9 × 0.8 cm. **Stipules** to 15 × 2.5 cm. **Leaves** distichous, subchartaceous, silvery below, prominently corrugated between lateral veins; *blade* oblong-elliptic, *30–50 × 16–24 cm*, base subcordate, apex obtuse to shortly acuminate; *lateral veins 28–36 pairs*, straight, prominent below; intercostal venation very slender, dense; petiole 3–5 cm long. **Inflorescences** to 16 cm long, 2–3-branched, terminal branches cymose; bracts ovate, to 40 × 25 mm, acute, amplexicaul. **Flowers:** buds to 20 × 8 mm; connectival appendage prominent, *c.* ½x the length of anther. **Fruits:** calyx lobes to 22 × 2 cm. **Nuts** ellipsoid, to 2.5 × 1.5 cm.

Vernacular names. Sarawak—*bilat* (Iban), *peran* (preferred name).

Distribution. Endemic in Borneo. In Sarawak known from Bintulu, Kapit, Limbang, Marudi, Miri, and Tatau districts (e.g., *S 13791*, *S 18176*, *S 23049*, *S 23471*, and *S 75391*). Also occurring in Brunei (e.g., *BRUN 901*, *BRUN 3136*, *FMS 30388*, and *SAN 17377*) and W Kalimantan.

Ecology. In mixed dipterocarp forest on moist lower slopes and periodically flooded alluvium, along the inland rivers, on clay soils, at altitudes to 300 m. The gigantic silvery fallen leaves on the forest floor look like crashed model zeppelins. Occurring in Mulu NP but vulnerable elsewhere.

3. **Parashorea malaanonan** (Blanco) Merr.

(Tagalog, *mala* = false, *anonang* = the custard apple; a putative vernacular name)

Sp. Blancoan. (1918) 271, PEB (1929) 400; Slooten *op. cit.* (1927) 375; Symington, Gard. Bull. S. S. 9 (1938) 334; Keith *op. cit.* 19; Masamune *op. cit.* 192; Browne *op. cit.* 128; Ashton *op. cit.* (1964) 84, *op. cit.* (1968) 38, *op. cit.* (1982) 383; Meijer & Wood *op. cit.* 192; Burgess *op. cit.* 143; Anderson *op. cit.* (1980) 118; PROSEA *op. cit.* 332; Newman *et al. op. cit.* 72; Coode *et al.* (eds.) *op. cit.* 73. **Basionym:** *Mocanera malaanonan* Blanco, Fl. Filip. ed. 1 (1837) 858. **Neotype** (designated here)**:** *Merrill Sp. Blancoan. 1053* (= *US 874771*), the Philippines, Luzon, Laguna Province, Mt. Maquiling (A, US). **Synonyms:** *Dipterocarpus malaanonan* (Blanco) Blanco, Fl. Filip. ed. 2 (1845) 312; *Shorea malaanonan* (Blanco) Blume Mus. Bot. Lugd. Bat. 2 (1852) 34; *Parashorea plicata* Brandis, J. Linn. Soc. Bot. 31 (1895) 104.

Large tree to 60 m tall, to 2 m diameter, *with dense dome-shaped crown*. **Bark** dark, eventually blackish purple, fissured, thinly flaky. *Young parts spasely greyish brown pubescent*, *glabrescent except on bud*, *inflorescence and nut.* **Twigs** *terete*, with amplexicaul stipule scars. Leaf buds lanceolate-falcate, to 6 × 2 mm. **Stipules** hastate, to 15 × 6 mm. **Leaves** thinly coriaceous, *with visible corrugations between lateral veins*, *greyish silvery lepidote below*; *blade broadly elliptic-ovate*, *9–15 × 3.5–7.5 cm*, base unequal, obtuse to broadly cuneate, margin wavy distally, apex acuminate, acumen to 1 cm long; *midrib prominent and glabrous below*; *lateral veins 9–14 pairs*, prominent below; intercostal venation slender, sinuate; *petiole 1.2–2 cm long*, *somewhat geniculate*, *glabrescent.* **Inflorescences** to 18 cm long, doubly branched. **Flowers:** buds to 14 × 8 mm; connectival appendage somewhat longer than anther. **Fruits:** calyx lobes to 16 × 1.7 cm. **Nut** to 1.7 cm diameter.

Vernacular names. Sabah—*urat mata daun licin* (preferred name). Sarawak—*urat mata* (preferred name).

Distribution. Borneo and the Philippines. In Sabah widespread and recorded from Beaufort, Kinabatangan, Kota Belud, Kota Merudu, Kudat, Lahad Datu, Papar, Ranau, Sandakan, Semporna, Sipitang, Tambunan, Tawau, and Tenom districts (e.g., *SAN 15225*, *SAN 17229*, *SAN 28928*, *SAN 30811*, and *SAN 76053*) and in Sarawak from Lawas and Miri districts (e.g., *S 3431*, *S 24976*, and *S 25329*). Also occurring in Brunei (e.g., *FMS 30531*, *KEP 80138*, *S 5728*, and *SAN 17065*) and E Kalimantan (e.g., *Endert 5165*).

Ecology. In mixed dipterocarp forest on deep friable clay soils overlying shale, basic and intermediate igneous rocks, at altitudes to 1300 m. Once abundant in the eastern parts of

Sabah lowlands and still locally so in surviving forests; rare in areas west of the Crocker Range (Sabah) and in Sarawak. Vulnerable.

Uses. In the past, the species supplied timber export from Sabah.

4. **Parashorea parvifolia** Wyatt Smith *ex* P.S.Ashton

(Latin, *parvus* = small, *folius* = leaf; small-leaved)

Gard. Bull. Sing. 19 (1962) 264, *op. cit.* (1964) 85, *op. cit.* (1968) 38, *op. cit.* (1982) 382; Meijer & Wood *op. cit.* 195; Burgess *op. cit.* 140; Anderson *op. cit.* 118; PROSEA *op. cit.* 332; Newman *et al. op. cit.* 73; Coode *et al.* (eds.) *op. cit.* 73. **Type:** *Haviland 2810/2331*, Sarawak, Belaga (holotype K).

Tree to 60 m tall, to 1.5 m diameter; *crown dense*, *dome-shaped*. **Bark** at first blackish purple. *Young parts pale yellowish brown puberulent*, *indumentum persistent only on bud*, *inflorescence*, *and ovary*. **Twigs** *terete*, slender; stipule scar short. Leaf buds to 3 × 1 mm. **Stipules** narrowly hastate, to 4 mm long, fugaceous. **Leaves** thinly coriaceous, *not corrugated*, *not silvery lepidote below*; *blade* elliptic to narrowly ovate, *6–9 × 3–4.5 cm*, base broadly cuneate, equal, apex with slender acumen to 1.5 cm long; midrib slender but elevated below; *lateral veins 8–10 pairs*, slender and hardly raised below, arching, well-spaced; intercostal venation subreticulate, well-spaced; petiole 1–1.8 cm long, somewhat geniculate. **Inflorescence** to 14 cm long, singly branched. **Flowers:** buds to 4.5 × 3 mm; connectival appendage short, slightly extruded above anther. **Fruits:** calyx lobes to 8.5 × 1.7 cm. **Nuts** to 1.5 cm diameter.

Vernacular names. Sabah—*urat mata daun kecil* (preferred name). Sarawak—*urat mata bukit* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Kota Belud, Labuk Sugut, Pandawan, Penampang, Pensiangan, Ranau, and Tenom districts (e.g., *SAN 37782*, *SAN 76191*, *SAN 95283*, and *SAN 119902*) and in Sarawak from Belaga, Bintulu, Lawas, Limbang and Miri districts (e.g., *KEP 79350*, *S 18194* and *S 43169*). Also occurring in Brunei (e.g., *BRUN 2604*, *BRUN 3013*, *BRUN 3381*, and *FMS 34567*) and E Kalimantan (e.g., *bb. 11772* and *bb. 18165*).

Ecology. Scattered, usually uncommon or rare in mixed dipterocarp forest on clay soils. Especially on upper slopes and ridges, and at altitudes to 1350 m in upper dipterocarp forest. Occurring in Lambir NP but vulnerable elsewhere.

5. **Parashorea smythiesii** Wyatt Smith *ex* P.S.Ashton

(B.E. Smythies, Conservator of Forests, Sarawak 1959–1964; ornithologist and botanist)

Gard. Bull. Sing. 19 (1962) 266, *op. cit.* (1964) 86, *op. cit.* (1968) 38, *op. cit.* (1982) 387; Meijer & Wood *op. cit.* 197; Burgess *op. cit.* 140; Anderson *op. cit.* 118; PROSEA *op. cit.* 332; Newman *et al. op. cit.* 74; Coode *et al.* (eds.) *op. cit.* 74. **Type:** *Ladi BRUN 2000a*, Brunei, Kuala Belalong (holotype K; isotypes KEP, L).

Large tree, to 55 m tall, to 1.2 m diameter; *crown dense*, *dome-shaped*. *Young parts pale yellowish brown scabrid-puberulent*, *indumentum persistent on inflorescence*, *bud and ovary*. **Twigs** *terete*, *c.* 3 mm diameter apically; stipule scars to 1.5 mm at first, horizontal.

Leaf buds to 5 × 3 mm. **Leaves** coriaceous, *silvery lepidote below*, drying greyish mauve above, *evidently corrugated between lateral veins*; *blade* elliptic-oblong, *10–18 × 4–7 cm*, base unequal, obtuse, apex with short slender acumen to 0.5 cm long; *midrib* prominent and *tomentose below*, narrowly furrowed above; *lateral veins 8–10 pairs*, prominent below, somewhat arched; intercostal venation distinct, dense; *petiole* 1.5–2.2 cm long, stout, *geniculate*, *tomentose*. **Inflorescences** to 10 cm long, doubly branched. **Flowers:** buds ovoid, to 7 × 4 mm; connectival appendage short, not exceeding anther. **Fruits:** calyx lobes to 10 × 1.7 cm. **Nuts** to 1.3 × 0.9 cm.

Vernacular names. Sabah—*urat mata batu* (preferred name). Sarawak—*meruyun* (Iban), *urat mata daun putih* (preferred name).

Distribution. Endemic in Borneo. In Sabah recorded from Beaufort, Sipitang and Tawau districts (e.g., *SAN 18720*, *SAN 25272*, *SAN 44595*, and *SAN 72180*) and in Sarawak from Belaga, Bintulu, Kapit, Limbang, Miri, and Tatau districts (e.g., *S 29151*, *S 32551*, *S 41302*, *S 41329*, and *S 56857*). Also occurring in Brunei (e.g., *BRUN 3016*, *BRUN 3169*, *FMS 35448*, and *KEP 80138*), and E Kalimantan (e.g., *bb. 17890* and *bb. 18320*).

Ecology. Locally frequent in mixed and occasionally upper dipterocarp forests on clay soils, at altitudes to 1000 m. Occurring in Lambir and Mulu NPs, probably not yet vulnerable.

6. **Parashorea tomentella** (Symington) Meijer Fig. 18.

(Latin, *tomentellus* = with small stuffing (e.g., of a pillow); the indumentum)

Acta Bot. Neerl. 12 (1963) 320; Meijer & Wood *op. cit.* 199; Burgess *op. cit.* 140; Ashton *op. cit.* (1982) 385; PROSEA *op. cit.* 333; Newman *et al. op. cit.* 75. **Basionym:** *Parashorea malaanonan* (Blanco) Merr. var. *tomentella* Symington *op. cit.* (1938) 338. **Type:** *Otik FMS 38745*, Borneo, Sabah, Sandakan district, Kabili-Sepilok FR (holotype KEP).

Large emergent tree, to 65 m tall, to 2 m diameter; *crown dense*, *dome-shaped*. *Young twigs*, *buds*, *leaf undersurface*, *petiole*, *inflorescence*, *bracts outside*, *parts of calyx and corolla exposed in buds*, *and ovary densely evenly more or less persistently pale tawny velutinous*. **Twigs** *c.* 3 mm diameter apically, much-branched, ribbed, *becoming terete*, smooth, dark brown; stipule scars slender, horizontal, amplexicaul. Buds lanceolate, acute, to 10 × 4 mm. **Stipules** narrowly lanceolate, to 16 × 6 mm. **Leaves** subcoriaceous, *subpersistently corrugated between veins*; *blade* elliptic-oblong, *10–20 × 5–10 cm*, base obtuse to subcordate, subequal (peltate in young trees and saplings), margin frequently narrowly subrevolute, apex subacute or broadly acuminate, acumen to 1 cm long; midrib stout and prominent below, elevated above; *lateral veins 11–13 pairs*, ascending, prominent below, somewhat arched; intercostal venation densely scalariform, evident and slightly elevated below; petiole 1.5–2.5 cm long, *c.* 3 mm diameter, stout, hardly geniculate. **Inflorescences** to 13 cm long, singly or doubly branched, branches bearing to 3 flowers; bracts lanceolate, to 10 × 4 mm. **Flowers:** buds broadly lanceolate, 15 × 10 mm; sepals narrowly deltoid; stamens somewhat shorter than style, filament compressed, tapering, anthers oblong-linear, connectival appendage shorter than anthers, stoutly acicular; ovary small, ovoid, style columnar, *c.* 5x the length of ovary, stout, pubescent but for the apical 1/5. **Fruits:** pedicels *c.* 3 mm long; calyx lobes aliform, 3 larger lobes spatulate, to 20 × 2.3 cm, obtuse, 2 shorter ones lorate, to 10 × 0.8 cm, acute. **Nuts** subglobose, to 2 cm diameter, verrucose, apiculate.

Vernacular name. Sabah—*urat mata beludu* (preferred name).

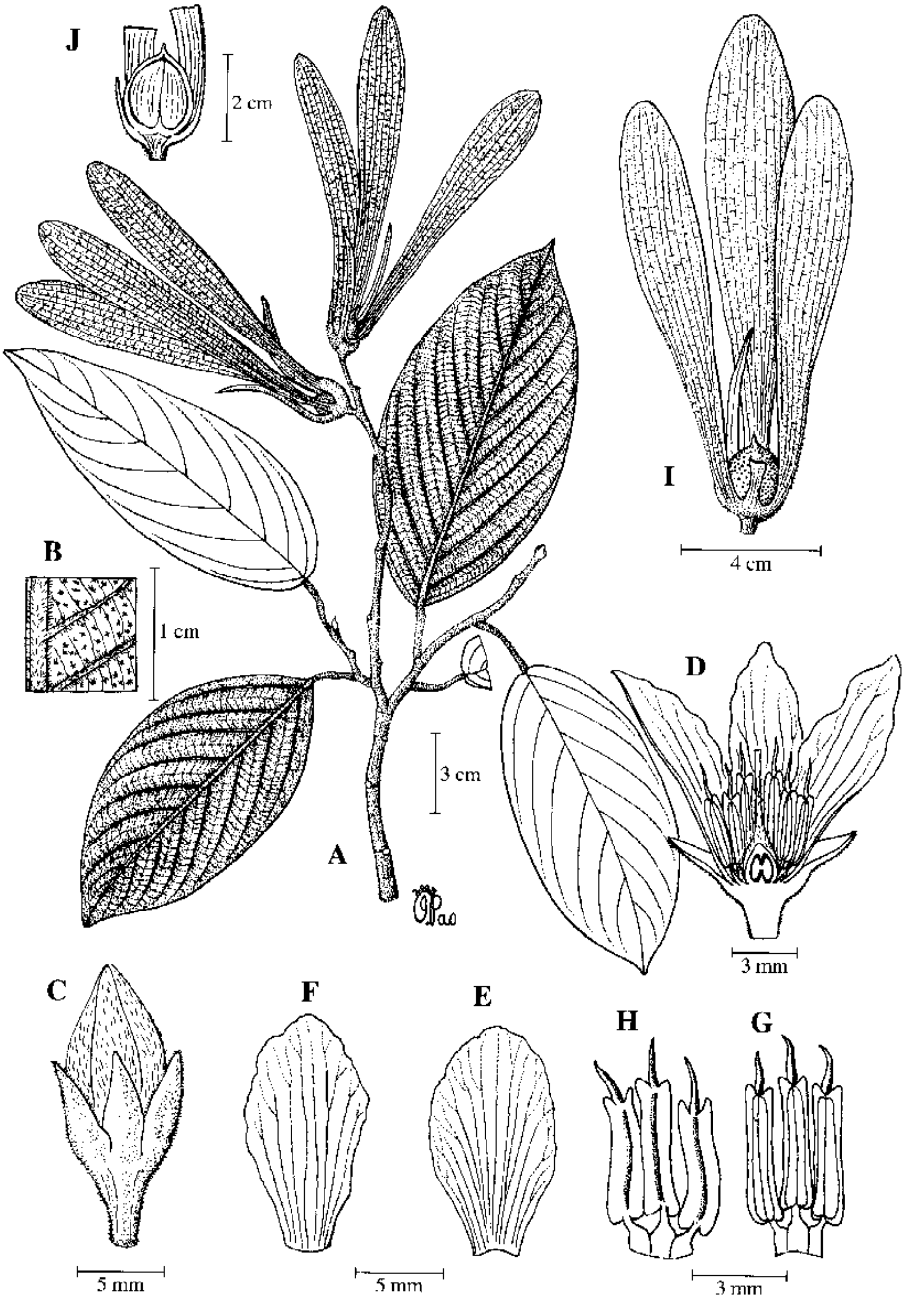

Fig. 18. *Parashorea tomentella.* A, fruiting leafy twig; B, detail of indumentum on lower leaf surface; C, flower bud; D, longitudinal section of open flower; E, adaxial view of petal; F, abaxial view of petal; G, adaxial view of stamens; H, abaxial view of stamens; I, fruit with one of the smaller calyx lobes cut-off; J, longitudinal section of fruit. (A–B from *SAN 18703*, C–H from *FMS 55170*, I–J from *SAN A 1464*.)

Distribution. Endemic in Borneo. In Sabah recorded from Kinabatangan, Labuk Sugut, Lahad Datu, Papar, Sandakan, and Tawau districts (e.g., *SAN 18785*, *SAN 31098*, *SAN 38163*, *SAN 96625*, and *SAN 134924*). Also occurring in E Kalimantan (e.g., *Ambriansyah & Arifin Berau 804*, *Ambriansyah & Arifin Berau 1050* and *Kessler et al. Berau 851*).

Ecology. Locally abundant in mixed dipterocarp forest on fertile clay soils, on undulating land and alluvium, at altitudes to 200 m. Vulnerable owing to forest conversion.

7. **SHOREA** Roxb. *ex* Gaertn.*f.*

(Sir John Shore, Governor-General for the British East India Company, 1793–1798)

lun, *meranti*, *selangan batu* (preferred names), *seraya*

Fruct. 3 (1805) 48; Brandis, J. Linn. Soc. Bot. 31 (1895) 73; Masamune, EPB (1942) 492; Symington, Malay. For. Rec. 16 (1943) 1; Ashton, MDB (1964) 115, MDBS (1968) 60, FM 1, 9 (1982) 436; Meijer & Wood, Sabah For. Rec. 5 (1964) 48; Burgess, TBS (1966) 134; Anderson, CLTS (1980) 118; PROSEA 5, 1 (1993) 384; Coode *et al.* (eds.), CLBD (1996) 74; Newman *et al.*, MDF-LHW (1996) 77, MDF-MHHW (1998) 159. **Synonyms:** *Doona* Thwaites *in* Hooker, Kew J. 3 (1851) *t. 14*; *Pentacme* A.DC., Prod. 16, 2 (1868) 626; *Isoptera* Scheff. *ex* Burck, Med. Lands Pl. Tuin 3 (1886) 27; *Ridleyinda* Kuntze, Rev. Gen. Pl. 1 (1891) 65; *Richetia* F.Heim, Bull. Mens. Soc. Linn. Paris (1891) 975; *Parahopea* F.Heim, Rech. Dipt. (1892) 66; *Pachychlamys* (Dyer *ex* King) Dyer *ex* Ridl., FMP 1 (1922) 233.

Emergent, sometimes main canopy trees; *buttresses stout or thin* (in most species of sect. *Shorea*), *somewhat concave*, *usually more or less as wide as tall*; stilt roots or flying buttresses rarely present; mature crown sympodial, hemispherical, spreading. **Bark** various. Stipule scars more or less short. **Leaves:** *blade pinnately veined*, *rarely with intermediates*; apex with tapering acumen, rarely caudate; *intercostal venation generally scalariform* (excepting, notably, many species of sect. *Richetioides*); petiole frequently but not generally geniculate. **Inflorescences** paniculate, terminal or generally 1-axillary, singly if axillary, doubly if terminal, branched, flowers secund. **Flowers:** buds lanceolate to spindle-shaped, occasionally subglobose (always so in sect. *Shorea* subsect. *Barbata*, sect. *Isoptera*, and sect. *Ovalis*); *sepals free down to receptacle*, *unequal or sometimes subequal*, *if unequal the 3 outer lobes longer than the 2 inner ones*; stamens 10–105, in 1, 2 or 3 whorls, or irregular; ovary usually pubescent, occasionally glabrous. **Fruits:** *calyx lobes unequal or subequal*, *expanded into a broad*, *saccate*, *spoon-shaped and distinctly imbricate base appressed to the nut*; *if unequal then all expanded into spatulate aliform lobes*, *with the 3 outermost lobes longer and broader than the 2 inner ones*, *if subequal then all 5 lobes are short but the outer 3 ones still somewhat thicker and longer than the inner 2* (all 5 equal, aliform, in *S. isoptera*). **Nuts** relatively large, *most usually pubescent*, *acute*, free from fruit calyx base, splitting irregularly at germination.

Distribution. About 196 species from S Asia through Indo-Burma and Malesia to the Philippines, Java and the Moluccas. One hundred thirty eight (138) species are known in Borneo, of which 91 are endemic, and 130 occur in Sabah and Sarawak. There are few local endemics, for instance between two major rivers, or confined to the Kinabalu Massif or the Bau limestone; but 65 species, not all of them endemic in Borneo Is. are restricted within Borneo to north of a line between Pontianak and Tidung in Kalimantan. Most of those are soils specialists, especially of white or yellow sands. Of these, many do not extend into Sabah beyond Sipitang and Beaufort districts in the south-west.

Ecology. The most frequently dominant genus in the emergent stratum of the zonal mixed and upper dipterocarp forests on yellow/red soils, at altitudes below 1200 m in W Malesia and the Philippines. A few, especially among the yellow meranti field group (sect. *Richetioides*) reach maximum height in the main canopy. In Sarawak, and Brunei still, most of the vast coastal peat swamp was dominated by the single species *Shorea albida*, the *alan*. Most species have narrow edaphic ranges within the dipterocarp forests. A few in our region, such as *S. retusa*, *S. revoluta* and *S. stenoptera* are confined to *kerangas* forest, others such as *S. inaequilateralis*, *S. macrantha*, *S. platycarpa*, *S. teysmanniana* and *S. uliginosa* to the peat swamp forests, and yet others including *S. platyclados*, *S. flaviflora* and *S. monticola* to upper dipterocarp forests; while *S. seminis* and several others are exclusively found on river banks and alluvium. Few species of dipterocarps are confined to limestone habitat, though *S. calcicola* appears to be a good example in our area. Other species found on limestone habitat either grow on acid organic soils overlying it on plateaux and are *kerangas* species, e.g., *S. multiflora*, or are species of the seasonal tropics which penetrate our area on dry limestone karst hills, e.g., *S. guiso* and *H. plagata*, or are species of mesic lower limestone slopes that occur elsewhere on clay soils over basic rocks, e.g., *S. isoptera* and *S. virescens*.

Uses. The most important timber genus in Sabah and Sarawak, albeit largely exhausted. The four field groups produce distinctively different timbers (*cf.* PROSEA *op. cit.* 1993). *Selangan batu* species yield heavy hard yellow-brown close-grained timbers suitable for decking, garden furniture and construction. White meranti timbers are pale, of medium density, and siliceous, suitable for veneer; yellow merantis yield a light hardwood pale yellow-brown in colour, and red merantis a pink to crimson hardwood of light to moderately heavy density that was until recently the most favoured tropical general utility hardwood on international markets. Several large-fruited species, mostly in botanical sect. *Pachycarpae* of the red meranti field group, continue to be harvested, on account of the high content of cocoa butter with an unusually high melting point in their fleshy cotyledons. This is mixed with true cocoa butter in chocolates, and for lipsticks and polishes.

Notes. *Shorea* is a very large genus, but fairly clearly divided into subgroups/sections based on characters of the stamens, and in many or some cases also the ovary, wood anatomy, bark anatomy and morphology, bud and leaf morphology, and resin chemistry. Six rather distinct field groups are also recognised, four of which occur in Sabah and Sarawak. Four of these six field groups exactly correlate with four of the botanical groupings, one includes two of them, but the largest field group, the red merantis, includes five botanical groups each with its distinct floral and bark characters. Meijer (Act. Bot. Neerl. 12 (1963) 322) recognised the red merantis as a botanical subgenus, *Rubroshorea*, solely on the basis of the pink to crimson red colour of the wood and inner bark. There are, however, exceptions even to this tenuous definition: *Shorea guiso*, in the *selangan batu* field group and botanical sect. *Shorea*, has red inner bark and heartwood, while *S. scaberrima*, whose wood anatomy and botanical grouping places it as a red meranti, has yellow-brown inner bark and heartwood. There is no single qualitative character which binds the red merantis as a natural botanical group.

A more serious problem has been revealed by molecular phylogenetic studies (Kamiya *et al. op. cit.* 1998; Dayanandan *et al. op. cit.* 1999), which indicate that three botanical groups within *Shorea*, namely *Anthoshorea*, *Doona* (of Sri Lanka) and *Pentacme* (Indo-Burma and the Philippines), are more closely related to *Hopea* and *Neobalanocarpus* than to other *Shorea*; and that *Parashorea* is closer to the ancestral line of those other *Shorea* than they are to that of *Shorea* sect. *Anthoshorea*, *Doona*, and *Pentacme*, and *Hopea* and *Neobalanocarpus*. Yet no character has been identified which characterises each of these two groups of *Shorea* sections separately. The two natural, phylogenetically separate major groupings within *Shorea*, cannot therefore be given generic status, recognizable in the herbarium or in the field. The alternative might be to give full generic status to the eleven currently recognised botanical sections. This would be difficult in some cases, such as sect. *Rubella* (red meranti), some of whose species share some characters with sect. *Brachyptera* (red meranti) or sect. *Anthoshorea* (white meranti). Perhaps more importantly, no-one who is interested in these trees who is not a botanist would welcome the division of the red merantis into 11 generic names. We, therefore, retain the commonly accepted definition and name of *Shorea*, perhaps the best known indigenous tree genus in Sabah and Sarawak, notwithstanding its paraphyletic origins.

Classification. In Borneo (Sabah and Sarawak), the genus *Shorea* as delimited in the present study can be subdivided into 9 sections base on the following combinations of vegetative and floral characters:

Key to Sections and Subsections of *Shorea*

1. Connectival appendage setose, stout; anthers 4-loculed, apices of anterior locules often also setose……………………………………………………………………………2

    sect. **Shorea** (*selangan batu* group)

    Flowers: petals cream, often pink at base; stamens 20–60, not distinctly whorled, filaments broad at base, gradually tapering, *anthers 4-loculed*, *each locule oblong*, *often setose distally*, ear-like with protruding base and apex, *connectival appendage hardly exceeding the length of anther*, *more or less setose*; ovary shortly conical, pubescent, with short columnar style. Leaf blade with conspicuous, flat or raised, or sometimes furrowed midrib above; intercostal venation densely scalariform, usually sinuate and hardly elevated.

    Connectival appendage generally sericeous or glabrous, if setose, then anthers glabrous and 2-loculed……………………………………………………………………………3

2. Flower buds ovoid to spindle-shaped; petals narrow, falling separately; connectival appendage sparsely setose……………………………….sect. **Shorea**, subsect. **Shorea**

    Flower buds globose; petals short, broadly oblong, connate at base on falling; connectival appendage and anther locule apices densely setose…………………………. ………………………………………………………..sect. **Shorea**, subsect. **Barbata**

3. Fruit calyx lobes far exceeding ripe nut, spatulate, wing-like but equal, patent; stamens 15, anthers subglobose, connectival appendage shorter than anther apices, stout, not recurved………………………………………………………………………………...

    sect. **Neohopea** (*selangan batu* group)

    Flowers small; buds globose; petals cream, broadly elliptic, falling separately; stamens to 15, in 3 whorls, filaments short, stout, hardly tapering compressed, anthers 4-loculed, locules subglobose, connectival appendage short, glabrous; ovary and stylopodium conical, style very short. Leaf blade with conspicuous, raised midrib on both surfaces; intercostal venation densely scalariform, slender, hardly raised below. Sapling leaves narrowly peltate.

Fruit calyx lobes unequal and spatulate, or equal and shorter than nut; stamens at least 30, anthers of other shapes, connectival appendage longer than anther apices or, if shorter, then recurved…………………………………………………………….…4

4. Anthers 2-loculed……………………………………………………………………..5

sect. **Richetioides** (yellow meranti group)

Flowers usually small; buds usually at most 5 × 3 mm, small; petals usually a shade of yellow, narrow, strongly twisted at anthesis forming a distinct albeit small cup at base enclosing the anthers, falling in rosette. Leaf blade with conspicuous, flat or somewhat furrowed midrib above; intercostal venation more or less reticulate or subscalariform with lesser cross-connecting veinlets. Opening leaves violet or magenta; sapling leaves often peltate.

Anthers 4-loculed...…6

5. Flower buds larger, broadly ovoid; stamens at least 100, not whorled, filaments gradually tapering, anthers lorate, connectival appendage shorter than anther apice, densely setose; ovary without stylopodium, style short broad, distinctly truncate, stigma ………………………………….……trifid……sect. **Richetioides**, subsect. **Polyandrae**

Flower buds usually smaller, ellipsoid or spindle-shaped; stamens (10–)15, in (2–)3 whorls, filaments tapering abruptly medially, anthers subglobose to broadly ellipsoid, connectival appendage aristate, much exceeding anther apice, sericeous or glabrous; ovary with prominent stylopodium, style long, slender, stigma not trifid……………….. …………………………………………….sect. **Richetioides**, subsect. **Richetioides**

6. Anther locules linear to oblong; filaments lorate or tapering gradually; ovary without stylopodium, style at least as long as ovary……………………………………….…7

Anther locules broadly oblong to subglobose; filaments tapering abruptly medially; ovary usually with distinct stylopodium, style usually short…………………….…8

7. Connectival appendage at least 3x the length of anther, frequently sericeous; wood pale yellow, vessel arrangement reticulate in TS, with silica…………………….……………

sect. **Anthoshoreae** (white meranti group)

Flowers usually large; buds ovoid; petals usually white, sometimes with pink median suffusion, broadly elliptic to ovate-lanceolate, contorted and imbricate at anthesis forming a broad goblet enclosing the anthers, loosely connate on falling; stamens 15–30, in 3 or more whorls, filaments broad at base, tapering gradually, anthers 4-loculed, locules narrowly oblong to lorate, connectival appendage aristate, erect, at least 3x longer than anther; ovary ovoid, without distinct stylopodium, style longer than ovary, filiform, stigma more or less distinctly trifid. Leaf blade more or less bent backward along midrib; midrib generally obscure, sunken above. Wood-ray cells containing silica crystals; vessels reticulately arranged in TS of the wood.

Connectival appendage less than ¾x the length of anther, usually stout and glabrous; wood pink, vessel arrangement loosely oblique in TS of wood, without silica..

sect. **Rubella** (red meranti group)

Flowers medium-sized; buds spindle-shaped; petals cream suffused with pink, lanceolate, contorted, imbricate at base forming a goblet enclosing the anthers, connate on falling; stamens 15–50, in 3 (if 15) or indistinct whorls, filaments lorate, gradually or abruptly tapering below anthers, anthers 4-loculed, connectival appendage short or exceeding the anther but of shorter length, tapering, glabrous, becoming recurved at anthesis; ovary with or without stylopodium, style columnar, stigma obscure. Leaf blade (in mature tree) more or less cream lepidote below; midrib conspicuous (except in *S. albida*); intercostal venation densely scalariform, hardly conspicuous. Wood without silica; vessels loosely diagonal to rays in TS.

8. Stamens 50–70, not in distinct whorls whorls, filaments very long, filiform, connectival appendage vestigial……………………………………………………………………...
   sect. **Ovalis** (red meranti group)
   Stipules and bracts not early caducous. Flower buds broadly ovoid; petals as in sect. Rubella; anthers subglobose, 4-loculed; ovary and stylopodium narrowly conical, style short. Leaf blade with obscure, sunken midrib above; intercostal venation scalariform.

   Stamens less than 30, in 3 whorls, filaments compressed and broad at base, connectival appendage aristate………………………………………………………………..…9

9. Connectival appendage at most as long as anthers, becoming more or less reflexed at anthesis; filaments applanate, tapering from the base to apex……………………....10
   sect. **Mutica** (red meranti group)
   Stipules and bracts early caducous (except in *S. quadrinervis*). Flower buds ovoid; petals as in sect. Rubella; stamens to 15, in 3 whorls, anthers 4-loculed, locules globose; ovary with distinct stylopodium, style shorter or only slightly longer than ovary. Leaf blade generally with obscure or very slender midrib above; intercostal venation scalariform.

   Connectival appendage at least 1½x the length of anther, not becoming reflexed at anthesis, filaments broad and flat at base, tapering abruptly medially and filiform below anthers………………………………………………………………………..…11

10. Bark surface mostly becoming deeply and persistently v-section fissured, rotting off only in large trees. Fruit calyx lobes not auriculate………sect. **Mutica,** subsect. **Mutica**

    Bark surface generally at first remaining smooth, then, after passing through a generally ephemeral shallowly v-section period, becoming chunkily flaky. Fruit calyx lobes auriculate at base……………………………..……….sect. Mutica, subsect. **Auriculatae**

11. Base of filaments connate at base but otherwise free; ovary ovoid without, or pyriform with, a stylopodium, style filiform, prominent…………………………………………...
    sect. **Brachypterae** (red meranti group)
    Inflorescences lax, with long branches; stipules and bracts at times somewhat persistent. Flower buds ovoid; petals as in sect. Rubella; stamens 15 or 24–28, in 3 whorls or indistinctly so, anthers 4-loculed, locules globose or broadly ellipsoid, connectival appendage 1½–3½x as long as anthers, slender, erect; ovary with distinct stylopodium, together pyriform, or ovoid without stylopodium but with puberulent style base. Leaf blade with conspicuous or obscure and shallowly sunken midrib above; intercostal venation scalariform. Bark cracking and becoming flaky in clean more or less flat thin pieces.

Margin of flattened bases of outer filaments united to form a tube around ovary; ovary ovoid, small, stylopodium tapering into style, style and stylopodium spindle-shaped, tapering at base and apex, or stylopodium indistinct and style filiform, more than 2½x the length of ovary……………………………………………………………………..

sect. **Pachycarpae** (red meranti group)

Stipules and bracts subpersistent, usually relatively large. Flower buds ovoid to fusiform; petals as in sect. Rubella; stamens to 15, in 3 whorls, filaments lorate, abruptly tapering and filiform below anthers; anthers subglobose to broadly ellipsoid, connectival appendage at least 2x as long as anther locules; ovary small, ovoid, with glabrous or glabrescent stylopodium. Bark remaining smooth, hoop-marked, pale greyish brown, eventually often becoming irregularly flaked and scroll-marked.

Key to *Shorea* species

(based on flowering and/or fruiting specimens)

1. Connectival appendage of stamen setose, stout; anthers 4-loculed, apices of anterior locules often also setose…………………………………………………………..…2
   Connectival appendage generally sericeous or glabrous but, if setose, then anthers glabrous and 2-loculed...…27

2. Flower buds ovoid to spindle-shaped, petals narrow, falling separately, connective appendage sparsely setose……………………………………………………….………3
   Flower buds globose, petals short, broadly oblong, connate at base on falling, connective appendages and apices of anther sacs densely setose………………..…22

3. Connectival appendage typically with 1–4 (a few with to 8) bristles, stamens otherwise glabrous……………………………………………………………..……4
   Connectival appendage with at least 5 bristles, shoulder of anther apices setose…....8

4. Lateral veins at least 15 pairs…………………………………………..…**49. S. guiso**
   Lateral veins at most 14 pairs…………………………………………………..……5

5. Fruit calyx lobes short, subequal…………………………………..…**50. S. havilandii**
   Fruit calyx lobes unequal, 3 larger ones wing-like……………………………...…6

6. Stamens at least 40………………………………………………**18. S. brunnescens**
   Stamens 20–30………………………………………………………………….…7

7. Lateral veins 10–12 pairs, dense. In mixed dipterocarp forest…..**114. S. scrobiculata**
   Lateral veins to 9 pairs, distant. In forest on limestone karst hills…….**20. S. calcicola**

8. Fruit calyx lobes subequal, shorter than nut………………………………………9
   Fruit calyx lobes unequal, wing-like, longer than the nut…………………….…10

9. Stamens *c.* 55; ripe nut to 5 × 5 cm………………………………..**46. S. geniculata**
   Stamens 30–40; nut at most 2 cm diameter……………………..…**115. S. seminis**

10. Staminal filaments setose along their distal margins……11
Staminal filaments glabrous……18

11. Leaf blade not eventually pale lepidote below……**45. S. foxworthyi**
Leaf blade of mature tree pale lepidote below……12

12. Twigs at first compressed……13
Twigs entirely terete……14

13. Tomentum on twig and petiole yellowish brown scabrid; petiole less than 1.5 cm long……**35. S. exelliptica**
Tomentum on twig and petiole buff, even; petiole at least 1.5 cm long……**56. S. inappendiculata**

14. Leaf blade falcate, base asymmetric; lateral veins slender below……15
Leaf blade more or less symmetric, base equal; lateral veins prominent below……16

15. Stamens 33–44……**38. S. falcifera**
Stamens 25–32……**74. S. materialis**

16. Stamens 25–33……**12. S. atrinervosa**
Stamens 35–46……17

17. Petiole at least 3.5 cm long……**27. S. crassa**
Petiole at most 2 cm long……**83. S. obscura**

18. Stamens at least 40……19
Stamens at most 37……20

19. Leaf with more or less equal base, not cream lepidote below; lateral veins 11–15 pairs, stout below……**69. S. lunduensis**
Leaf falcate, cream lepidote below (mature trees); lateral veins 8–12 pairs, slender below……**39. S. falciferoides** (subsp. **glaucescens**)

20. Lateral veins 16–24 pairs, puberulent below……**121. S. superba**
Lateral veins at most 16 pairs, not puberulent below……21

21. Lateral veins 11–16 pairs; domatia minute……**53. S. hypoleuca**
Lateral veins at most 12 pairs; domatia prominent, pore-like……**33. S. domatiosa**

22. Stamens at least 45……**63. S. laevis**
Stamens at most 35……23

23. Leaf blade less than 8 cm long; lateral veins 6–7 pairs, not sunken above……24
Leaf blade at least 10 cm long; lateral veins at least 8 pairs, sunken above or not….25

24. Fruit calyx lobes subequal, shorter than nut……**11. S. asahi**
Fruit calyx lobes unequal, wing-like, longer than nut……**77. S. micans**

25. Fruit calyx lobes unequal, wing-like, longer than nut…………...**75. S. maxwelliana**
Fruit calyx lobes subequal, shorter than nut……………………………………..…26

26. Leaf blade coriaceous; lateral veins 5–6 pairs, not sunken above……**62. S. ladiana**
Leaf blade thin-textured; lateral veins at least 8 pairs, slightly sunken above…………
……………………………………………………………………………**16. S. biawak**

27. Fruit calyx lobes far exceeding the length of ripe nut, spatulate, wing-like but equal, patent; stamens 15, anthers subglobose, connectival appendage not exceeding the anther apice, stout…………….…………………………………………**58. S. isoptera**
Fruit calyx lobes either unequal and spathulate, or equal and shorter than nut; connectival appendage as long as or longer than the anther apice or, if shorter, either recurved or stamens at least 20……………………………………………….…28

28. Anthers 2-loculed...…29
Anthers 4-loculed...…57

29. Flower buds large, broadly ovoid; stamens at least 100, filaments gradually tapering, anthers lorate, connectival appendage shorter than anther apice, densely setose; ovary ovoid, without stylopodium, style short, broad, distinctly trifurcate..**99. S. polyandra**
Flower buds usually small, ellipsoid or spindle-shaped; stamens (10–)15, in (2–)3 whorls; anther locules subglobose to broadly ellipsoid, tapering abruptly medially, connectival appendage aristate, much exceeding anther apice, sericeous or glabrous; ovary with prominent stylopodium, with long slender style, stigma not trifid……30

30. Fruit calyx lobes shorter than nut, subequal………………………………….....31
Fruit calyx lobes longer than nut, wing-like, unequal………………………………47

31. Nut glabrous, shiny, drying black…………………………………………………32
Nut pubescent, drying dull, pale……………………………………………….…33

32. Petiole at most 1.2 cm long; ovary glabrous; stamens *c.* 15…………**67. S. longiflora**
Petiole at least 1.8 cm long; ovary puberulent; stamens *c.* 10…..**71. S. macrobalanos**

33. Leaf blade less than twice as long as wide………………………………………34
Leaf blade more than twice as long as wide.……………………………………..39

34. Stamens 16–17…………………………………………………….…**106. S. richetia**
Stamens 10–15……………………………………………………………………35

35. Leaf venation persistently cream puberulent below..............................…**65. S. laxa**
Leaf entirely glabrous……………………………………………………………36

36. Mature tree leaf deeply peltate; understorey tree with smooth bark……**94. S. peltata**
Juvenile leaf peltate only; canopy tree with flaky bark………………………..…37

37. Leaf blade 7–12 cm long; lateral veins 5–7 pairs; nut to 3 × 1.3 cm, drying mauve puberulent..…**14. S. balanocarpoides**

Leaf blade at most 8 cm long; lateral veins at least 7 pairs; nut to 2 × 1.2 cm, cream buff tomentose (rarely glabrous)……………………………………………………….…38

38. Lateral veins 8–10 pairs, hardly raised below; blade base not decurrent; petiole drying rugulose; ovary without distinct stylopodium……………..…**80. S. multiflora**
Lateral veins 7–9 pairs, slender but distinctly raised below; blade base shortly decurrent; petiole drying smooth, black; ovary with distinct stylopodium…………….
……………………………………………………………………………**92. S. patoiensis**

39. Leaf blade greyish brown scabrid-pubescent below..……………..…**57. S. induplicata**
Leaf glabrous, or venation alone pubescent below..…40

40. Midrib and lateral veins shallowly furrowed above…………..…**120. S. subcylindrica**
Midrib and lateral veins not furrowed above…………………………………….…41

41. Leaf venation puberulent below...………………………………………………42
Leaf venation entirely glabrous……………………………………………………43

42. Blade base equal; midrib prominently narrowly furrowed above…...**82. S. obovoidea**
Blade base unequal; midrib not narrowly furrowed above…………….…**22. S. chaiana**

43. Petiole persistently pale cream, puberulent or glabrous...................................…44
Petiole drying greyish brown or black, glabrous……………………………………45

44. Petiole at least 1.9 cm long; blade greyish matte below; stamens *c.* 10; fruit calyx lobes subpatent…………………………………………………….…**23. S. collaris**
Petiole less than 1.5 cm long; blade pale tawny below; stamens *c.* 15; fruit calyx lobes clasping the nut…………………………………………….…**9. S. angustifolia**

45. Twig slender, pale; leaf blade dull below; distal end of petiole drying cream………...
…………………………………………………………………**123. S. tenuiramulosa**
Twig stout, drying dark; leaf blade shiny below; petiole drying entirely black…….46

46. Leaf blade coriaceous; midrib flat above……………………….…**13. S. bakoensis**
Leaf blade thin-textured; midrib raised above………………….…**130. S. xanthophylla**

47. Petiole at least 1.9 cm long; lateral veins at least 10 pairs……………………….…48
Petiole at most 1.8 cm long or, if longer; lateral veins less than 9 pairs…………….…49

48. Petiole 3–4 mm diameter, stout; blade thickly coriaceous………………**54. S. iliasii**
Petiole less than 2 mm diameter; blade chartaceous…………..….**37. S. faguetioides**

49. Lateral veins at least 14 pairs……………………………………...…**6. S. alutacea**
Lateral veins at most 12 pairs…………………………………………………..…50

50. Leaf venation persistently tomentose below…………………………………..…51
Leaf venation glabrescent or glabrous below………………………………………53

51. Leaf blade more or less densely pale greyish green puberulent below………………...
…………………………………………………………………**68. S. longisperma**

Leaf blade glabrous; venation scabrid-puberulent below………………………….….52

52. Leaf margin revolute; lateral veins 9–12 pairs; tomentum scabrid…………………….
………………………………………………………………….**1. S. acuminatissima**
Leaf margin not revolute; lateral veins 7–9 pairs; tomentum even…….**47. S. gibbosa**

53. Lateral veins very slender, hardly raised, with distinct shorter intermediates; midrib drying reddish or blackish, frequently with paired glabrous pore-like domatia at base ………………………………………………………………….…**52. S. hopeifolia**
Lateral veins stout, without intermediates; midrib not drying darker than blade, distinctly raised, without domatia…………………………………………………54

54. Petiole 1.7–2.2 cm long……………………………………………**60. S. kudatensis**
Petiole at most 1.6 cm long…………………………………………………………55

55. Lateral veins 5–7 pairs…………………………………………….…**29. S. cuspidata**
Lateral veins at least 8 pairs………………………………………………………56

56. Lateral veins *c.* 8 pairs, prominently raised below; leaf margin narrowly revolute…...
…………………………………………………………………..**79. S. mujongensis**
Lateral veins 9–12 pairs, raised but not prominent below; leaf margin not revolute….
…………………………………………………………………**36. S. faguetiana**

57. Anther locules linear to oblong; filaments lorate or tapering gradually; ovary without stylopodium, style at least as long as ovary……………………………………….58
Anther locules broadly oblong to subglobose; filaments tapering abruptly medially; ovary usually with distinct stylopodium……………………………………………72

58. Connectival appendage at least 3x the length of anther, frequently sericeous; wood pale yellow, vessel arrangement reticulate in TS, with silica……………………….59
Connectival appendage less than ¾x the length of anther, usually stout, glabrous; wood pink, vessel arrangement loosely oblique in TS; silica absent……………….69

59. Stamens at least 17………………………………………………………………60
Stamens to 15……………………………………………………………………61

60. Stamens *c.* 17; blade undersurface pale pink lepidote (mature trees); lateral veins 20–24 pairs………………………………………………………………**31. S. dealbata**
Stamens *c.* 25; blade not pale lepidote below; lateral veins at most 14 pairs………….
…………………………………………………………………..**48. S. gratissima**

61. Leaf venation persistently tomentose below...…62
Leaf venation early glabrescent below...…64

62. Tomentum red- to cream-brown; leaf blade oblong-ovate, bright yellow lepidote below……………………………………………………………....**84. S. ochracea**
Tomentum dull greyish to tawny brown; blade obovate or ovate-oblong not pale lepidote below……………………………………………………………….……63

63. Leaf blade obovate; lateral veins at most 17 pairs; twig at first compressed……………………………………………………………………………**127. S. virescens**
Leaf blade ovate-oblong; lateral veins 17–26 pairs; twig terete……**64. S. lamellata**

64. Lateral veins at least 15 pairs; twigs at first compressed……………………………65
Lateral veins at most 15 pairs or, if more, then twigs terete………………………66

65. Fruit pedicel *c.* 1 cm long, *c.* 5 mm diameter; receptacle obconical; longer fruit calyx lobes to 18 cm long……………………………………………**122. S. symingtonii**
Fruit pedicel at most 2 mm long and diameter; receptacle cup-shaped, abruptly constricted at base; longer fruit calyx lobes at most 13 cm long……..**25. S. cordata**

66. Twig apices more or less compressed; leaf blade subchartaceous, drying chocolate-brown…………………………………………………………**17. S. bracteolata**
Twig terete; leaf blade coriaceous, drying tawny to pale yellowish brown…………67

67. Base of leaf blade cuneate……………………………………………**103. S. resinosa**
Base of leaf blade obtuse to subcordate……………………………………………68

68. Base of fruit impressed; flower bud to 5 × 2.5 mm…………………………**3. S. agamii**
Base of fruit tapering; flower bud to 9 × 5 mm…………………………**24. S. confusa**

69. Midrib obscure above; twigs compressed………………………………**4. S. albida**
Midrib conspicuous above; twigs terete……………………………………………70

70. Stamens 25…………………………………………………………………**32. S. dispar**
Stamens 15–20……………………………………………………………………....71

71. Stamens 15…………………………………………………………**108. S. rubella**
Stamens 19–20……………………………………………………………**34. S. elliptica**

72. Stamens 50–70, connectival appendage vestigial, filaments very long, filiform………………………………………………………………………………**85. S. ovalis**
Stamens less than 30, connectival appendage aristate, filaments compressed and broad at base……………………………………………………………………………73

73. Connectival appendage aristate, at least 1½x the length of anther, not reflexed, filaments broad and flat at base, tapering abruptly and filiform below anthers……..74
Connectival appendage at most of the same length as anther, generally becoming reflexed at anthesis; filaments flat, tapering from base to apex……………………106

74. Filaments broad at base, tapering abruptly medially and filiform below anthers, connate at base but otherwise free; ovary ovoid without, or pyriform with, a stylopodium, style filiform, prominent……………………………………………75
Margins of flattened bases of outer filaments united to form a tube round the ovary; stylopodium tapering into style, style and stylopodium spindle-shaped, tapering at base and apex, or stylopodium indistinct and style more than 2½x the length of ovary, filiform……………………………………………………………………96

75. Stamens 24–28……………………………………………………….…**117. S. smithiana**
Stamens 15………………………………………………………………………..…76

76. Ovary without distinct stylopodium, ovoid, style at least as long as ovary, generally puberulent in the basal half…………………………………………………………77
Ovary and stylopodium distinctly pyriform, style shorter than both, glabrous…….89

77. Leaf blade falcate, base distinctly unequal………………..…**55. S. inaequilateralis**
Leaf and base more or less symmetrical………………………………………………78

78. Leaf blade below, petiole and young twig scabrid-tomentose…………………..…79
Leaf blade below, petiole and young twig shortly evenly tomentose or glabrous…..81

79. Leaf blade coriaceous, margin revolute, cream-lepidote below (mature trees); longer fruit calyx lobes to 6.5 × 2.5 cm……………………………………**43. S. flemmichii**
Leaf blade more or less chartaceous, margin not revolute, not lepidote below; longer fruit calyx lobes to 14 × 2.5 cm……………………………………………………80

80. Leaf blade concave; tomentum drying paler than blade undersurface….…**5. S. almon**
Leaf blade flat; tomentum drying same colour or darker than blade undersurface…… ……………………………………………………………………**91. S. parvistipulata**

81. Lateral veins at least 13 pairs, very slender, hardly raised below; intercostal venation not raised, densely scalariform……………………………………………………..…82
Lateral veins, if more than 13 pairs, prominent below; intercostal venation not as above……………………………………………………………………………………83

82. Leaf blade 10–15 × 5–8 cm, base subpeltate discernable as a rib over the base of the midrib (mature trees); stipule scars cuneate……………………..…**26. S. coriacea**
Leaf blade 6–10 × 3–5 cm, base not subpeltate; stipule scars long, often amplexicaul ……………………………………………………………………..…**126. S. venulosa**

83. Lateral veins at least 16 pairs; blade pinkish cream lepidote below…..**128. S. waltoni**
Lateral veins at most 16 pairs; blade not pale lepidote below…………………..…84

84. Petiole 4–6 cm long………………………………………………….…**87. S. pachyphylla**
Petiole at most 3.5 cm long……………………………………………………………85

85. Connectival appendage scarious……………………………………**93. S. pauciflora**
Connectival appendage glabrous…………………………………………………....86

86. Leaf blade with to 3 pairs of pale scale-like domatia at base……..…**59. S. johorensis**
Leaves without scale-like domatia………………………………………………….87

87. Leaf thickly coriaceous; style glabrous. In karapa forest, at 800–1200 m altitudes…... ………………………………………………………………………**21. S. carapae**
Leaf thinly coriaceous; style densely pubescent at least in basal ¼. In flood plain and mixed dipterocarp forest, at altitudes to 600 m…………………………………..…88

88. Fruit calyx lobes shorter than nut…………………………………...**88. S. palembanica**
Fruit calyx lobes wing-like, much longer than nut………………..…**8. S. andulensis**

89. Twigs compressed; midrib sharply acute below; lateral veins hardly raised below…...
……………………………………………………………………..**98. S. platyclados**
Twigs terete; midrib terete but prominent below; lateral veins distinctly raised…....90

90. Fruit calyx lobes less than 2x the length of nut…………………………………...91
Fruit calyx lobes at least 3x the length of nut……………………………………..…92

91. Ovary and stylopodium hardly distinguishable, filiform towards apex, stouter below, frequently further swollen in the basal half, style short; ripe nut to 5 × 2.5 cm……….
……………………………………………………………………..**112. S. scaberrima**
Ovary and stylopodium ovoid, crowned by a filiform style equal in length; ripe nut to 3.5 × 1.5 cm……………………………………………………………………**40. S. fallax**

92. Ovary and stylopodium densely pubescent but for the short style apex………………..
…………………………………………………………………………..**101. S. pubistyla**
Ovary and stylopodium puberulent, glabrescent to glabrous or if puberulent, then style equal in length…………………………………………………………………93

93. Connectival appendage exceeding the style at anthesis, very slender, crisped; leaf blade bullate between intercostal veins; venation below, petiole and twig scabrid-tomentose………………………………………………………..…**19. S. bullata**
Connectival appendage not exceeding style at anthesis, awn-like; leaf blade flat, evenly tomentose or glabrous……………………………………………………..…94

94. Ovary and stylopodium glabrescent, *c.* 2x the length of style; anther locules large, strongly tapering to and fused at apex…………………………..…**42. S. flaviflora**
Ovary and stylopodium puberulent, equal to style length; anther locules not large, hardly tapering, free…………………………………………………………………...95

95. Lateral veins 13–19 pairs; blade golden lepidote (mature trees) below, without domatia..…………………………………………………………**78. S. monticola**
Lateral veins 6–8 pairs; blade glabrous, with pore-like domatia……..**61. S. kunstleri**

96. Stipule scars amplexicaul…………………………………………………………97
Stipule scars prominent but not amplexicaul…………………………………..…104

97. Leaf blade densely golden-brown tomentose below, with axillary domatia……………..
………………………………………………………………………….**95. S. pilosa**
Leaf blade sparsely short-tomentose or glabrous below………………………..…98

98. Stipules with cordate subequal base………………………………...**118. S. splendida**
Stipules not cordate at base……………………………………………………...…99

99. Leaf base peltate……………………………………………………..…**129. S. woodii**
Leaf base cordate, obtuse or cuneate……………………………………………..…100

100. Lateral veins 11–20 pairs; nut to 6 × 4 cm; longer fruit calyx lobes to 11 cm long ……………………………………………………………………………………..…101
Lateral veins 9–12 pairs; nut to 3.7 × 2.5 cm; longer fruit calyx lobes exceeding 15 cm long……………………………………………………………………………102

101. Inflorescences to 35 cm long, axillary on modified sections of the twig with short internodes and rudimentary or aborted leaves; stipules to 2 cm long, subrevolute…… ……………………………………………………………………..**119. S. stenoptera**
Inflorescences to 20 cm long, in axils of normal leaves on normal twig; stipules to 5 cm long, flat………………………………………………………**72. S. macrophylla**

102. Leaf blade at least 25 cm long…………………………………..…**100. S. praestans**
Leaf blade at most 21 cm long……………………………………………………103

103. Leaf blade broadly ovate to suborbicular, 10–13 cm wide………**107. S. rotundifolia**
Leaf blade elliptic, 5–8 cm wide………………………………..…**7. S. amplexicaulis**

104. Leaf base cordate; undersurface densely persistently golden pubescent……………… ……………………………………………………………………**76. S. mecistopteryx**
Leaf base not cordate; tomentum caducous or not golden, or leaf glabrous……105

105. Stipule scars short, horizontal or somewhat ascending; lateral veins 11–14 pairs……. ……………………………………………………………………..**15. S. beccariana**
Stipule scars falcate, descending; lateral veins mostly 14–19 pairs…...**96. S. pinanga**

106. Fruit calyx lobes auriculate at base……………………………………………..…107
Fruit calyx lobes not auriculate at base………………………………………………112

107. Leaf blade narrowly oblong; lateral veins at least 19 pairs……………………..…108
Leaf blade elliptic, oblong to lanceolate; lateral veins at most 15 pairs………..…110

108. Leaf blade concave boat-shaped; lateral veins sunken above……..…**116. S. slootenii**
Leaf blade flat; lateral veins prominent above……………………………………109

109. Leaf blade sparsely tufted pubescent or glabrescent below; lateral veins 24–28 pairs ……………………………………………………………………..**81. S. myrionerva**
Leaf blade densely shortly persistently scabrid-puberulent below; lateral veins 19–25 pairs…………………………………………………………………..…..**111. S. sagittata**

110. Leaf blade 14–26 × 6.5–12 cm, thickly coriaceous……………………..…**2. S. acuta**
Leaf blade 7–16 × 2.2–6 cm, thinly coriaceous………………………………..…111

111. Leaf blade lustrous below; lateral veins prominent………………**73. S. macroptera**
Leaf blade dull below; lateral veins hardly raised, very slender……**41. S. ferruginea**

112. Stipules exceeding 20 mm long, broad, boat-shaped, prominently ribbed, coriaceous, not early caducous……………………………………………**102. S. quadrinervis**
Stipules at most 19 mm long, chartaceous, flat, not prominently ribbed, early caducous…………………………………………………………………………..113

113. Flower buds at least 14 mm long……………………………………………………114
Flower buds at most 10 mm long……………………………………………………115

114. Petiole at most 0.6 cm long; leaf base cordate, unequal…………..…**70. S. macrantha**
Petiole 0.6–1.2 cm long; leaf base obtuse, equal……………………………………
……………………………………………**51. S. hemsleyana** (subsp. **grandiflora**)

115. Leaf blade glabrous below……………………………………………………………116
Leaf blade sparsely or densely tomentose or pale lepidote below.......................…118

116. Apex of leaf blade retuse…………………………………………..…**104. S. retusa**
Apex of leaf blade acuminate……………………………………………………..…117

117. Lateral veins 8–9 pairs, with prominent axillary pore-like domatia…………………...
…………………………………………………………………**44. S. foraminifera**
Lateral veins 11–12 pairs, with at most a few pairs of small domatia at the midrib base……………………………………………………..…**124. S. teysmanniana**

118. Leaf with at least 14 pairs of lateral veins or, if sometimes with as few as 11, greyish brown scabrid, cream pubescent or lepidote below, or with pale scale-like domatia up sides of midrib…………………………………………………………………..…119
Leaf with at most 13 pairs of lateral veins, or if tomentum as above, then with at most 10 pairs of lateral veins; domatia and indumentum not as above……………125

119. Leaf blade evenly pinkish brown velutinous below; lateral veins 20–25 pairs, with prominent intermediates………………………………………..…**10. S. argentifolia**
Leaf blade not pinkish brown velutinous below; lateral veins less than 21 pairs, without intermediates……………………………………………………………..…120

120. Leaf venation, petiole and twigs densely scabrid-tomentose………………………121
Leaf venation, petiole and twigs sparsely or evenly tomentose………………..…124

121. Leaf blade cream lepidote below...…**89. S. pallidifolia**
Leaf blade not lepidote below...…122

122. Leaf blade ovate-elliptic, finely scabrid; lateral veins slender below…………………..
……………………………………………………………………**30. S. dasyphylla**
Leaf blade oblong-elliptic, oblong-obovate, or oblong-ovate; lateral veins stoutly prominent below…………………………………………………………………..…123

123. Leaf blade concave, chartaceous; petiole 2.2–3.2 cm long…………**125. S. uliginosa**
Leaf blade flat, thickly coriaceous; petiole 1.3–2.3 cm long……….......**110. S. rugosa**

124. Leaf blade (mature tree) pinkish buff puberulent below; lateral veins 12–15 pairs…...
………………………………………………………………………**66. S. leprosula**
Leaf blade (mature tree) sparsely scabrid below; lateral veins 16–20 pairs…………...
…………………………………………………………………**97. S. platycarpa**

125. Leaf blade narrowly ovate to lanceolate, cream to pink lepidote below (mature tree); lateral veins slender, hardly raised below……………**28. S. curtisii** (subsp. **curtisii**)

Leaf blade elliptic or broadly ovate, not cream or pink lepidote below; lateral veins prominent……………………………………126

126. Leaf blade shiny below……………………………………127
Leaf blade dull below……………………………………128

127. Leaf blade elliptic, 5–9 × 3–5 cm, margin hardly or not revolute, apex shortly acuminate or frequently retuse……………………**113. S. scabrida**
Leaf blade broadly ovate, 10–15 × 5.5–10 cm, margin prominently revolute, apex prominently acuminate……………………**105. S. revoluta**

128. Leaf blade broadly ovate; lateral veins 8–10 pairs……………………**86. S. ovata**
Leaf blade ovate to elliptic; lateral veins *c.* 11 pairs……………………129

129. Leaf blade below, petiole and twigs densely deep rufous-brown scabrid-puberulent…
……………………**109. S. rubra**
Leaf blade below, petiole and twigs densely evenly pale brown puberulent…………..
……………………**90. S. parvifolia**

Key to *Shorea* species

(based on field characters)

(**Caution:** this key is only reliable for leaves from mature trees; juveniles have smooth bark; in saplings, leaves often lack pale lepidote blade undersurfaces, blades are larger, narrower, with more prominent acumens and frequently more veins, petioles are longer, more slender, frequently geniculate)

1. Wood hard, dense, ray ends glistening on tangential surface (observable with the aid of hand lens)……………………………………2
Wood relatively soft, ray ends not glistening on tangential surface……………………5

2. Inner bark and heartwood orange red to meat-red; leaf base sometimes prominently unequal……………………………………3
Inner bark and heartwood cream-brown or, if reddish, inner bark evenly textured; leaf base subequal to equal……………………………………7

Selangan batu (preferred name); Sabah and Sarawak—*selangan* (lighter wood species, Malay), *tekam* (Iban) (sect. **Shorea** and sect. **Neohopea)**

Buttresses prominent, narrow, sharp (except in *S. geniculata*, *S. isoptera*, *S. superba*). Bark thin, hard, dull greyish brown to fawn, occasionally tawny or chocolate, indistinctly small-lenticellate, becoming longitudinally cracked and oblong flaky, the flakes thin, with flat clean surfaces (both sides); inner bark relatively thin, close-textured, hard, homogeneous yellowish brown paling towards cambium (rarely pink to red). Sapwood close-textured, glistening on tangential surface and readily exuding dammar; heartwood chocolate-brown to dark reddish brown; dammar frequent on bark as cream to cream yellow opaque incrustations or smears.

3. Inner bark dense, homogeneous. Lateral veins typically at least 15 pairs……………..
……………………………………………………………**49. S. guiso** (in part)
Inner bark fibrous. Lateral veins at most 13 pairs………………………………..…4

4. Leaf base equal…………………………………………….**61. S. kunstleri** (in part)
Leaf base prominently unequal..……………………**55. S. inaequilateralis** (in part)

5. Inner bark distinctly laminated………………………………………………..…35
White meranti; Sabah—*melapi* (preferred name); Sarawak—*raruk* (Iban) (sect. **Anthoshorea**)
Buttresses more or less prominent, stout. Bark pale or dark, thick irregular-section cracked, eventually rotting off in chunky flakes, the lower and subsequent surfaces rough, powdery, rarely thinly flaky; inner bark laminated cream to yellow to orange-brown, thick, fibrous. Sapwood pale yellow, coarse; heartwood indistinct; dammar incrustations pale to bright yellow. Leaf midrib obscure, more or less sunken above.
Inner bark not distinctly laminated…………………………………………………6

6. Dammar dark brown to black on fresh surfaces, often as coxcombs on bark, or as copious incrustations. Bark tawny (except in *S. acuminatissima*), becoming vertically cleanly cracked and thinly oblong flaky, the flakes with clean surfaces; inner bark fibrous, tawny brown with a greenish tinge at the cambium……………………......45
Yellow meranti; Sabah—*seraya kuning*, yellow seraya (preferred names); Sarawak—*damar hitam* (preferred name), *lun* (light; Iban), *merakunyit* (heavy; Iban) (sect. **Richetioides**)
Buttresses small or prominent, stout. Sapwood dull yellow to lemon yellow; heartwood pale tawny brown. Twigs commonly striated or rugulose. Leaf generally drying yellowish brown to greenish brown; intercostal venation reticulate or, if subscalariform, with distinct cross-connections, generally drying darker than blade. Sapling leaves often peltate.
Dammar incrustations opaque, cream to yellow. Bark variously smooth, fissured or cleanly flaky, greyish to pinkish or chocolate-brown; inner bark meat-red or plum- to crimson-brown, rarely coffee-coloured……………………………………….…76
Red meranti; Sabah—*seraya*, red seraya (preferred name); Sarawak—*lop* (Iban), *perawan* (Iban) (sect. **Brachypterae**, sect. **Mutica**, sect. **Ovalis**, sect. **Pachycarpae** and sect. **Rubella**)
Buttresses generally prominent, stout. Sapwood cream to pale yellow. Midrib usually evident, sometimes obscure sunken above; blade drying grey- to pink-brown.

7. Bark surface covered with a superficial but distinct pattern of small v-section fissures and sharp narrow ridges, pale grey, eventually patchily cracked and peeling…………
…………………………………………………………………….**16. S. biawak**
Bark at first smooth, becoming flaky, yellow- to chocolate-brown………………..…8

8. Leaf blade white or cream lepidote below...…9
Leaf not pale lepidote below………………………………………………….…24

9. Petiole more than 3.5 cm long……………………………………………….…10
Petiole less than 3.5 cm long……………………………………………….……11

10. Leaf blade broadly ovate to orbicular; lateral veins drying black; petiole white lepidote……………………**46. S. geniculata**
Leaf blade narrowly ovate to elliptic; lateral veins not drying black; petiole cream pubescent……………………**27. S. crassa**

11. Midrib persistently or caducous pubescent below……………………12
Midrib glabrous below……………………15

12. Lateral veins less than 9 pairs……………………**83. S. obscura**
Lateral veins more than 9 pairs……………………13

13. Venation scabrid-tomentose below……………………**35. S. exelliptica**
Venation evenly tomentose below……………………14

14. Lateral veins at most 15 pairs……………………**115. S. seminis** (in part)
Lateral veins at least 16 pairs……………………**121. S. superba**

15. Lateral veins at least 15 pairs……………………16
Lateral veins at most 14 pairs……………………17

16. Leaf blade cream lepidote below; lateral veins drying cream or yellowish brown below; petiole 1–1.6 cm long……………………**114. S. scrobiculata** (in part)
Leaf blade white lepidote below or drying greyish brown; lateral veins drying black or greyish brown below; petiole 1.5–2.6 cm long……………………**56. S. inappendiculata**

17. Petiole 0.7–1 cm long……………………**75. S. maxwelliana**
Petiole at least 1.1 cm long……………………18

18. Leaf venation drying black below……………………19
Leaf venation drying cream to pale brown below……………………21

19. Leaf blade coriaceous; lateral veins stout, prominent below; petiole stout……………………**12. S. atrinervosa**
Leaf blade chartaceous to thinly coriaceous; lateral veins slender, hardly raised; petiole slender……………………20

20. Petiole 1–1.5 cm long; leaf blade falcate; lateral veins without domatia…**63. S. laevis**
Petiole 1.5–2.5 cm long; leaf blade broadly ovate, subequal; lateral veins with pore-like domatia……………………**33. S. domatiosa**

21. Leaf lateral veins 11–16 pairs, stout, prominent below……………………**53. S. hypoleuca**
Leaf lateral veins at most 12 pairs, elevated but not prominent below……………………22

22. Leaf base unequal; blade subfalcate; petiole and midrib cream lepidote; twig glabrescent. In *kerangas* forest……………………**74. S. materialis**
Leaf base subequal; blade not falcate; petiole and twig cream puberulent. In mixed dipterocarp forest……………………23

23. Leaf blade 6.5–12 × 2.5–5 cm. In forest on sandy soils west of Batang Lupar (Sarawak)……………………**38. S. falcifera**

Leaf blade 10–18 × 4.5–8 cm. In forest on clay soils east of Batang Lupar…………....
……………………….………………….**39. S. falciferoides** (subsp. **glaucescens**)

24. Midrib puberulent above………………………………………………………….…25
Midrib glabrous above…………………………………………………………..…29

25. Midrib glabrous below...…26
Midrib puberulent below………………………….………….…………….……27

26. Leaf thickly coriaceous; lateral veins *c.* 9 pairs, lax. In forest on limestone karst hills
…………………………………….…………………………..…**20. S. calcicola**
Leaf thinly coriaceous; lateral veins 9–12 pairs, dense. In *kerangas* forest or in forest on organic soils over limestone…………………………….……**50. S. havilandii**

27. Twig compressed…………………….……………….…….…**45. S. foxworthyi**
Twig terete…………………….……………………………….…….………..…28

28. Petiole at least 1 cm long…………………………………....**115. S. seminis** (in part)
Petiole at most 0.8 cm long……………………..…**114. S. scrobiculata** (in part)

29. Petiole at most 1.1 cm long; lateral veins at most 10 pairs…………….……..…30
Petiole at least 1.2 cm long or, if less, then leaf with more than 10 pairs of lateral veins……………………………………………………………………………….32

30. Leaf blade larger, 10–14 × 4.5–7.5 cm; lateral veins at most 6 pairs…..**62. S. ladiana**
Leaf blade smaller, 5–10 × 1.8–5 cm; lateral veins at least 6 pairs…………………31

31. Species of ultrabasic soils (Sabah)……………………………..….**77. S. micans**
Species of shallow humic soils on high ridge crests…………………….**11. S. asahii**

32. Leaf blade base shortly decurrent into petiole; lateral veins somewhat sunken above; sapling leaf peltate………………………………………………..…**58. S. isoptera**
Leaf base not decurrent; lateral veins not sunken; sapling leaf not peltate…………33

33. Inner bark pink. Lateral veins and midrib drying distinctly black below.……………..
…………………………………………………………………**49. S. guiso** (in part)
Inner bark yellowish brown. Lateral veins and midrib not drying black below.……34

34. Leaf blade at most 6 cm wide; petiole 1–1.5 cm long; intercostal venation subreticulate……………………………………………….…**18. S. brunnescens**
Leaf blade at least 6 cm wide; petiole 2–3.5 cm long; intercostal venation densely scalariform…………………………………………………….**69. S. lunduensis**

35. Leaf venation persistently tomentose below…………….……………………..…36
Leaf venation glabrescent or glabrous below..………….……………………...37

36. Leaf undersurface grey tomentose; lateral veins 20–25 pairs……...…**64. S. lamellata**
Leaf undersurface bright yellow lepidote; lateral veins 25–30 pairs....**84. S. ochracea**

37. Leaf pale pinkish brown lepidote below; lateral veins 20–24 pairs…...**31. S. dealbata**
Leaf undersurface not pale lepidote below; lateral veins at most 18 pairs………..…38

38. Leaf base cuneate……………………………………………………………39
Leaf base obtuse or subcordate……………………………………………..…40

39. Midrib slender, acute; lateral veins hardly raised below………..…**48. S. gratissima**
Midrib stout, terete; lateral veins distinctly raised below………..…**103. S. resinosa**

40. Leaf blade chartaceous, drying undulate, chocolate-brown…………………………41
Leaf blade coriaceous, drying not undulate, tawny to pale yellowish brown………42

41. Leaf base usually subcordate; lateral veins 15–18 pairs, prominent below……………………………………………………………………………**25. S. cordata**
Leaf base obtuse; lateral veins 11–15 pairs, slender and not prominent below…………………………………………………………………………**17. S. bracteolata**

42. Twig compressed apically; lateral veins 22–26 pairs……………..…**127. S. virescens**
Twig terete apically; lateral veins at most 22 pairs………………………………..…43

43. Leaf base more or less cordate; lateral veins at least 18 pairs……**122. S. symingtonii**
Leaf base obtuse; lateral veins at most 18 pairs……………………………………44

44. Leaf blade thinly coriaceous; lateral veins (9–)13–18 pairs, slender, not prominent below, drying paler than the blade……………………………………**24. S. confusa**
Leaf blade thickly coriaceous; lateral veins 9–13 pairs, stout and prominent below, drying of the same colour as blade……………………………………**3. S. agamii**

45. Bark deeply fissured, overall appearing more fissured than flaky………………...46
Bark smooth or appearing flaky rather than fissured………………………………48

46. Leaf blade persistently scabrid-tomentose or sometimes also cream-lepidote below, drying rich rust-brown. Bark dark chocolate-brown…………..**1. S. acuminatissima**
Leaf blade glabrous or glabrescent on the veins below, drying dull greyish brown to tawny. Bark tawny brown……………………………………………………..…47

47. Bark surface at first reticulate v-section fissured…………**29. S. cuspidata** (in part)
Bark surface square-section fissured……………………..…**36. S. faguetiana** (in part)

48. Mature tree leaf deeply peltate; smooth barked subcanopy tree……..…**94. S. peltata**
Juvenile leaf peltate only; main canopy or emergent tree at maturity…………..…49

49. Leaf blade drying dark reddish brown, purplish rufous lepidote below……………………………………………………………………………**99. S. polyandra**
Leaf blade drying tawny to greyish green, not lepidote below………………..…50

50. Midrib and lateral veins more or less persistently tomentose below………….…51
Leaf blade entirely glabrous……………………………………………………58

51. Leaf blade greyish brown scabrid-tomentose below…………………………..…52
Leaf blade evenly or yellowish brown tomentose below.....................................…53

52. Leaf base cordate, margin revolute………………………………**57. S. induplicata**
Leaf base obtuse, margin not revolute…………………………**68. S. longisperma**

53. Petiole 2.2–3 cm long; lateral veins 12–14 pairs……………..…**54. S. iliasii** (in part)
Petiole less than 2 cm long or, if 2.2 cm, leaf with less than 11 pairs of lateral veins..54

54. Lateral veins 14–19 pairs……………………………………………**6. S. alutacea**
Lateral veins less than 13 pairs……………………………………………….……55

55. Midrib hidden and sunken above…………………………………**82. S. obovoidea**
Midrib clearly evident, at most shallowly furrowed above…………………..….56

56. Leaf base unequal………………………………………………….**22. S. chaiana**
Leaf base more or less equal…………………………………………………..…57

57. Twig smooth, persistently tomentose; leaf base obtuse………………..**65. S. laxa**
Twig glabrescent, rugulose; leaf base cuneate………………………**47. S. gibbosa**

58. Leaf blade dull greyish lepidote below………………………………..**23. S. collaris**
Leaf tawny brown, glabrous below………………………………………….….59

59. Leaf blade more than 3x as long as broad…………………………………….….60
Leaf blade less than 3x as long as broad………………………………………..…62

60. Leaf margin prominently revolute; lateral veins 12–15 pairs. In forest on acid humic soils…………………………………………………………..…**67. S. longiflora**
Leaf margin hardly or not revolute; lateral veins at most 13 pairs. In forest on non-humic clay soils……………………………………………………………….….61

61. Leaf blade 12–15 × 4–7 cm; petiole 0.8–1.5 cm long, glabrous, drying black………...
…………………………………………………………………**130. S. xanthophylla**
Leaf blade 8–14 × 2.5–4 cm; petiole 0.6–0.8 cm long, puberulent, drying brownish cream...……**9. S. angustifolia**

62. Petiole at least 3 mm diameter……………………………………………….…63
Petiole at most 2 mm diameter……………………………………………….…64

63. Leaf blade with revolute margin and cordate base…………..…**71. S. macrobalanos**
Leaf blade with flat margin and cuneate to obtuse base………..**54. S. iliasii** (in part)

64. Petiole 2–3 cm long; leaf blade frequently subcordate at base, chartaceous; lateral veins 10–15 pairs………………………………………………**37. S. faguetioides**
Petiole at most 1.8 cm long or, if longer, leaf blade coriaceous and with at most 7 pairs of lateral veins…………………………………………………………..…65

65. Leaf margin revolute…………………………………………………………..…66
Leaf margin flat…………………………………………………………..……68

66. Leaf base cuneate; lateral veins 5–7 pairs……………………………**106. S. richetia**
Leaf base obtuse; lateral veins at least 7 pairs……………………………………67

67. Leaf blade ovate; midrib furrowed above…………………….…**79. S. mujongensis**
Leaf blade oblong-lanceolate; midrib flat above…………………..…**13. S. bakoensis**

68. Leaf blade narrow, at least twice as long as wide………………………………69
Leaf blade broad, less than twice as long as wide………………………………70

69. Midrib and lateral veins evident but shallowly grooved above; canopy tree with flaky bark…………………………………………………………**120. S. subcylindrica**
Midrib and lateral veins not furrowed above; subcanopy tree with smooth bark……... …………………………………………………………………**123. S. tenuiramulosa**

70. Bole eventually scroll-marked, smooth overall with patchy flakes…………………… …………………………………………………………**29. S. cuspidata** (in part)
Bole becoming evenly flaky……………………………………………………………71

71. Petiole at least 1 cm long; leaf blade 7–15 cm long………………………………72
Petiole at most 1 cm long; leaf blade 2.5–8 cm long………………………………74

72. Leaf blade thinly coriaceous; lateral veins at most 7 pairs, prominent below………… ……………………………………………………………**14. S. balanocarpoides**
Leaf blade thickly coriaceous; lateral veins at least 7 pairs, hardly raised below…..73

73. Lateral veins 7–9 pairs; petiole at least 1.7 cm long………………**60. S. kudatensis**
Lateral veins 9–12 pairs; petiole at most 1.5 cm long…..…**36. S. faguetiana** (in part)

74. Leaf blade narrowly ovate; lateral veins 7–9 pairs, slender but prominent below……. ……………………………………………………………………**92. S. patoiensis**
Leaf blade broadly ovate; lateral veins 8–11 pairs, hardly raised below................75

75. Midrib drying dark purplish brown to red below; vast emergent tree………………… ……………………………………………………………………**52. S. hopeifolia**
Midrib drying of the same colour as blade; low emergent or main canopy tree………. ……………………………………………………………………**80. S. multiflora**

76. Bark remaining smooth, hoop-marked, or eventually becoming cracked or shallowly v-section fissured, and sometimes patchily flaky…………………………………77
Bark early becoming flaky or deeply fissured……………………………………90

77. Stipule scars amplexicaul…………………………………………………………78
Stipule scars not amplexicaul………………………………………………………85

78. Stipules ovate, cordate, subpersistent; leaf blade glabrous……………………………79
Stipules oblong to hastate; leaf blade glabrous or pubescent…………………………80

79. Twigs with sections with short internodes and no leaves…………**119. S. stenoptera**
Twigs without leafless sections with short internodes…………..…**118. S. splendida**

80. Leaf base peltate……………………………………………………..…**129. S. woodii**
Leaf base cordate, obtuse or cuneate………………………………………………81

81. Leaf blade densely golden brown tomentose below; lateral veins with prominent tomentose domatia……………………………………………………**95. S. pilosa**
Leaf blade sparsely puberulent or glabrous below; lateral veins without domatia….82

82. Stipules falcate, subacute; twigs less than 3 mm diameter apically, slender……83
Stipules oblong to hastate, obtuse; twigs at least 3 mm diameter apically, stout…...84

83. Leaf blade broadly ovate to suborbicular, 10–13 cm wide………**107. S. rotundifolia**
Leaf blade elliptic, 5–8 cm wide…………………………..…**7. S. amplexicaulis**

84. Petiole 1.5–3 cm long. In forest on clay rich soils…….**72. S. macrophylla** (in part)
Petiole 3.5–4.5 cm long. In forest on sandy soils…………………**100. S. praestans**

85. Twigs distinctly compressed apically. Bark remaining smooth or becoming shallowly flaky……………………………………………………………………….….86
Twigs more or less terete apically. Bark becoming v-section fissured, eventually powdery chunkily flaky……………………………………………………….…88

86. Leaf base cordate, blade densely golden tomentose below…………………………………………………………………………………**76. S. mecistopteryx** (in part)
Leaf base cuneate or obtuse, blade not densely golden tomentose below………….87

87. Stipule scars short, horizontal or ascending. Leaf blade dull below; lateral veins 11–14 pairs………………………………………………..…**15. S. beccariana** (in part)
Stipule scars falcate, descending. Leaf blade shiny below; lateral veins 14–19 pairs……………………………………………………………………………**96. S. pinanga**

88. Tomentum on veins and twigs even, short; lateral veins slender, hardly raised below..……………………………………………………………**41. S. ferruginea** (in part)
Tomentum on veins and twig scabrous; lateral veins stout, prominent below……...89

89. Leaf blade 14–26 × 6.5–12 cm. Inner bark plum-red………..…**2. S. acuta** (in part)
Leaf blade 8–16 × 4–6 cm. Inner bark pale pinkish brown………………………………………………………………………...**73. S. macroptera** (in part)

90. Leaf base distinctly unequal, subcordate……………………………………..…91
Leaf base equal or subequal…………………………………………………..…92

91. Leaf blade evenly tomentose below; lateral veins 11–13 pairs………………………..……………………………………………………**55. S. inaequilateralis** (in part)
Leaf blade scabrid-tomentose below; lateral veins 13–17 pairs……**70. S. macrantha**

92. Leaf blade cream, pink or golden lepidote below…………………………………...93
Leaf blade not distinctly lepidote below...….102

93. Twig compressed apically…………………………………………………………94
Twig terete or ribbed apically……………………………………………………..…95

94. Lateral veins 11–14 pairs……………………………….…**15. S. beccariana** (in part)
Lateral veins 16–20 pairs………………………………………….…**4. S. albida**

95. Lateral veins 9–11 pairs……………………………………………………..…96
Lateral veins 5–7 or at least 10 pairs……………………………………………97

96. Leaf blade pink lepidote below; lateral veins hardly raised below………………………………………….....**28. S. curtisii** (subsp. **curtisii**)
Leaf blade more or less cream lepidote below; lateral veins prominent below……….. ……………………………………………………………**32. S. dispar** (in part)

97. Leaf blade golden lepidote below. In montane forest at altitude above 900 m……….. ……………………………………………………………………**78. S. monticola**
Leaf blade cream lepidote below. In lowland forest at altitude to 800 m……….…98

98. Lateral veins 5–7 pairs…………………………………………..…**108. S. rubella**
Lateral veins at least 10 pairs……………………………………………..…99

99. Bark appearing flaky rather than fissured. Leaf blade thinly coriaceous, sparsely lepidote below, base narrowly cuneate…………………………..…..**8. S. andulensis**
Bark prominently v-section fissured. Leaf blade chartaceous or thickly coriaceous, evenly or scabrid-tomentose, base obtuse to cordate (occasionally broadly cuneate) ……………………………………………………………………………….100

100. Leaf blade chartaceous; lateral veins at least 18 pairs; tomentum if present even……. …………………………………………………………………….**128. S. waltoni**
Leaf blade thickly coriaceous; lateral veins at most 19 pairs; tomentum scabrid….101

101. Leaf blade 13–22 × 7–13 cm, ochreous scabrid below...…………..**89. S. pallidifolia**
Leaf blade 7–16 × 4–9 cm, evenly cream lepidote below except on veins…………… ……………………………………………………………………**34. S. elliptica**

102. Lateral veins at most 13 pairs……………………………………………..…..103
Lateral veins at least 14 pairs……………………………………………..…130

103. Bark appearing fissured rather than flaky……………………………………..104
Bark appearing flaky rather than fissured………………………………………122

104. Leaf venation below entirely tomentose…………………………………..…..105
Leaf blade below glabrous or puberulent on midrib and lateral veins only……..…114

105. Leaf tomentum scabrid or tufted………………………………………………..106
Leaf tomentum even, short………………………………………………………..109

106. Bark shallowly cracked. Leaf blade somewhat bullate between intercostal veins……. …………………………………………………………….**19. S. bullata** (in part)
Bark becoming more or less deeply v-section fissured. Leaf blade flat………..…107

107. Leaf blade sparsely tometose below………………………**113. S. scabrida** (in part)
Leaf blade densely tomentose below……………………………………………..108

108. Tomentum tawny, prominently tufted……………………..…**110. S. rugosa** (in part)
Tomentum yellowish brown, scabrous…………….…………….….**30. S. dasyphylla**

109. Leaf margin more or less revolute……….…………………….…………………..110
Leaf margin flat……………………………………………………………….113

110. Leaf margin prominently revolute; blade coriaceous, glabrescent, shiny below. In *kerangas* forest……………………………………………….….…**105. S. revoluta**
Leaf margin narrowly slightly revolute; blade thinly coriaceous, not shiny below. In other forest types……………………………………………………………….111

111. Tomentum rich vinous reddish brown…………………………………**109. S. rubra**
Tomentum cream to brown………………….………………….………….112

112. Leaf blade 6–11 × 3.5–6 cm; lateral veins 10–13 pairs, the basal pair often with large pale glabrous domatia……………………………………………..**90. S. parvifolia**
Leaf blade 4–8 × 2.5–4.5 cm; lateral veins 8–10 pairs, with small hairy domatia in their axils……………………………………………………………….…**86. S. ovata**

113. Leaf blade 5–9 × 3–5 cm, glabrescent below; lateral veins 8–11 pairs, without prominent domatia…………….…………………………..**113. S. scabrida** (in part)
Leaf blade 8–14 × 3.5–5.5 cm, sparsely pale brown puberulent below; lateral veins 12–15 pairs, sparsely puberulent with pale scale-like domatia in rows up the midrib (immature), or with densely cream-buff puberulent undersurface without domatia…..
……………………………………………………………**66. S. leprosula** (in part)

114. Lateral veins only 4 pairs; blade concave............................…**102. S. quadrinervis**
Lateral veins at least 5 pairs; blade flat……………………………….…….....115

115. Petiole 4–6 cm long; blade broadly ovate to orbicular, 10–20 × 9–16 cm, thickly coriaceous. In peat swamp forest and poorly drained *kerangas*…..**87. S. pachyphylla**
Petiole less than 3.5 cm long; blade otherwise. In other types of habitat.…………116

116. Petiole at most 1.7 cm long……………….………………….………….…..117
Petiole at least 2 cm long…………………….…………….…………….…120

117. Leaf apex retuse……………………………………….…………..**104. S. retusa**
Leaf apex acuminate…………………………………….……………….118

118. Leaf base cuneate; lateral veins without domatia. On inland hills……………………..
…………………………………………………………….**32. S. dispar** (in part)
Leaf base obtuse; lateral veins with domatia. In lowland swamps and valleys……119

119. Lateral veins 8–9 pairs with prominent axillary domatia up the midrib……….……..
………………………………………………………………..**44. S. foraminifera**
Lateral veins 11–12 pairs with a few pairs of small domatia towards the midrib base only..…………………………………………………..…**124. S. teysmanniana**

120. Lateral veins 11–13 pairs; leaf margin revolute…………………......**21. S. carapae**
Lateral veins 6–8 pairs; leaf margin flat…………………………………..…121

121. Leaf blade narrowly ovate, drying rust-brown below; lateral veins slender but prominent below, ascending. Bark dark chocolate-brown………..…**42. S. flaviflora**
Leaf blade broadly ovate, drying dull greyish; lateral veins slender and hardly raised below, spreading. Bark pale greyish brown……………..….**61. S. kunstleri** (in part)

122. Stipule scars amplexicaul……………………………….…**72. S. macrophylla** (in part)
Stipule scars not amplexicaul………………………………………………………..123

123. Leaf blade scabrid-tomentose below…………………………………………..…124
Leaf blade evenly tomentose, glabrous or glabrescent below...........................…..125

124. Leaf blade concave, with revolute margin, more or less bullate between intercostal veins..……………………………………………………………..…**19. S. bullata** (in part)
Leaf blade flat, margin not revolute……………………**91. S. parvistipulata** (in part)

125. Lateral veins 8–9 pairs. Inner bark plum-red……………………….….**93. S. pauciflora**
Lateral veins at least 10 pairs. Inner bark rust-, plum- or yellow-brown……..……126

126. Leaf base with to 3 pairs of pale scale-like domatia in the axils of the basal lateral veins below..……………………………………………………..**59. S. johorensis**
Leaf base without pale scale-like domatia……………………………………..…127

127. Leaf blade drying deep reddish brown below, purplish brown above…………………………………………………………………………..**88. S. palembanica** (in part)
Leaf blade drying pale orange-rust below, pale pinkish brown above……………128

128. Lateral veins hardly raised below; blade dull lepidote below…………………………………………………………………………………..**41. S. ferruginea** (in part)
Lateral veins prominent below; blade glabrescent, somewhat shiny below..……..129

129. Leaf blade 14–26 × 6.5–12 cm..…………………………………**2. S. acuta** (in part)
Leaf blade 8–16 × 4–6 cm………………………………..**73. S. macroptera** (in part)

130. Leaf blade evenly pubescent or glabrous below…………………………………..…131
Leaf blade scabrid-tomentose below…………………………………………….…140

131. Lateral veins very slender, hardly raised below………………………………..…132
Lateral veins prominent below……………………………………………………..…135

132. Bark cracked, scaly, rather than fissured…………………..**41. S. ferruginea** (in part)
Bark appearing fissured rather than flaky……………………………………..…133

133. Midrib sharply acute, prominent below; blade lanceolate, margin undulate, base inrolled; petiole 1–1.5 cm long……………………………………**98. S. platyclados**
Midrib terete below; blade broadly ovate, margin not undulate, base not inrolled; petiole at least 1.5 cm long…………………………………………………………..134

134. Leaf blade 10–15 × 5–8 cm, base subpeltate, margin revolute. Stipule scars cuneate ………………………………………………………………………**26. S. coriacea**

Leaf blade 6–10 × 3–5 cm, base not subpeltate, margin hardly revolute. Stipule scars amplexicaul……………………………………………………………**126. S. venulosa**

135. Bark flaky……………………………………………………………………………136
Bark fissured rather than flaky…………………………………………………138

136. Leaf blade oblong, base cordate, undersurface golden tomentose…………………… ……………………………………………………**76. S. mecistopteryx** (in part)
Leaf blade if oblong and with cordate base, then not golden tomentose below…...137

137. Leaf blade densely pale cream-buff puberulent below, or sparsely pale brown puberulent and with pale scale-like domatia running alongside the midrib…………… ……………………………………………………………**66. S. leprosula** (in part)
Leaf blade glabrous below but for sparsely buff-puberulent midrib and lateral veins, without domatia…………………………………………**88. S. palembanica** (in part)

138. Leaf blade 6–11 × 2.5–4.5 cm, densely pinkish buff-velutinous below……………… ……………………………………………………………………**10. S. argentifolia**
Leaf blade at least 8 × 4.5 cm, not densely velutinous below……………………139

139. Bark deeply fissured. Leaf blade elliptic-oblong to broadly ovate; lateral veins 16–20 pairs. In mixed peat swamp forest…………………………**97. S. platycarpa** (in part)
Bark shallowly fissured. Leaf blade narrowly oblong; lateral veins 24–28 pairs. On river banks…………………………………………………**81. S. myrionerva** (in part)

140. Bark cracked and flaky, not deeply fissured…………………………………………141
Bark appearing fissured rather than flaky…………………………………………145

141. Leaf venation densely scabrid-tomentose below……………………………………142
Leaf venation sparsely tomentose below……………………………………………144

142. Leaf blade concave………………………………………………**5. S. almon** (in part)
Leaf blade flat……………………………………………………………………………143

143. Leaf blade narrowly oblong to lanceolate, coriaceous; tomentum pink-brown……… ……………………………………………………………………**111. S. sagittata**
Leaf blade broadly oblong to elliptic, thinly coriaceous; tomentum pale yellow- to grey-brown……………………………………………**91. S. parvistipulata** (in part)

144. Leaf blade 14–26 × 6.5–12 cm. Inner bark plum-red………………**2. S. acuta** (in part)
Leaf blade 8–16 × 4–6 cm. Inner bark pale pinkish brown…………………………… ……………………………………………………………**73. S. macroptera** (in part)

145. Bark dark warm brown to blackish, deeply fissured………………………………146
Bark pinkish to greyish brown, shallowly or deeply fissured……………………151

146. Inner bark yellowish or pinkish brown………………………………………………147
Inner bark rich meat red……………………………………………………………150

147. Leaf blade concave……148
Leaf blade flat……149

148. Petiole 2.2–3.2 cm long. In mixed peat swamp forest……**125. S. uliginosa**
Petiole 1–1.8 cm long. In forest on clay soils……**5. S. almon** (in part)

149. Petiole 1.3–2.3 cm long……**110. S. rugosa** (in part)
Petiole 2.5–4 cm long……**101. S. pubistyla**

150. Leaf blade ovate, 5–9 × 3–4.5 cm; lateral veins 14–17 pairs. Bark blackish……**43. S. flemmichii**
Leaf blade broadly oblong, 11–22 × 4–7 cm; lateral veins 25–34 pairs. Bark rich reddish brown……**116. S. slootenii**

151. Leaf blade at least 3x as long as broad……152
Leaf blade at most 2½x as long as broad……153

152. Leaf blade 12–17 × 2–4.5 cm, bending back along the midrib, densely tomentose below; lateral veins 20–25 pairs……**85. S. ovalis**
Leaf blade 12–25 × 4.5–9 cm, remaining flat, sparsely tomentose below; lateral veins 24–28 pairs……**81. S. myrionerva** (in part)

153. Bark shallowly patchily flaky……154
Bark deeply fissured……156

154. Lateral veins 18–22 pairs. Inner bark pink……**91. S. parvistipulata** (in part)
Lateral veins 14–17 pairs. Inner bark yellowish brown……155

155. Lateral veins with short intermediate veins……**112. S. scaberrima**
Lateral veins without short intermediate veins……**51. S. hemsleyana** (subsp. **grandiflora**)

156. Lateral veins without distinct intermediate veins. In mixed peatswamp forest……**97. S. platycarpa** (in part)
Lateral veins with distinct intermediate veins. In mixed dipterocarp forest……157

157. Petiole 0.8–1.5 cm long; leaf not lepidote below; lateral veins 15–20 pairs……**40. S. fallax**
Petiole 2.2–2.7 cm long; leaf frequently dull greyish lepidote below (mature trees); lateral veins 14–17 pairs……**117. S. smithiana**

1. **Shorea acuminatissima** Symington

(Latin, *acuminatissimus* = prominently acuminate; the leaf apex)

(sect. **Richetioides**; yellow meranti)

Gard. Bull. S. S. 9 (1938) 340; Browne, FTSB (1955) 162; Ashton *op. cit.* (1964) 149, *op. cit.* (1968) 81, *op. cit.* (1982) 482; Meijer & Wood *op. cit.* 65; Burgess *op. cit.* 217; Anderson *op. cit.* (1980) 121; PROSEA *op. cit.* 417; Coode *et al.* (eds.) *op. cit.* 74; Newman *et al. op. cit.* (1996) 109. **Type:** *Ayan FMS 38723*, Borneo, Sabah, Sandakan (holotype KEP).

Vast emergent tree, to 70 m tall, to 2 m diameter; buttresses tall, stout. **Bark** *dark chocolate-brown*, *deeply square-section fissured*, the ridges only later becoming flaky; *inner bark tawny-brown*, *fibrous*, not distinctly laminated. *Twig*, *inflorescence*, *petiole*, *leaf bud*, *parts of flower exposed in bud*, *stipules and venation below more or less persistently rusty-brown scabrid-pubescent*. **Twigs** *c.* 1.5 mm diameter apically, terete, much-branched. Leaf buds ovoid, to 1.2 mm long. **Stipules** *oblong-falcate*, *c. 6 × 3.5 mm*, *base obtuse to subcordate*, *somewhat persistent in young trees*. **Leaves** *glabrous or sometimes cream-lepidote below*, *coriaceous*, *drying rich rusty-brown or cream below with the veins usually darker*; *blade ovate*, *7–10 × 3–4 cm*, *base obtuse*, *margin revolute*, *apex with acumen to 0.7 cm long*; *midrib evident but sunken above*, *prominent below*; *lateral veins 9–12 pairs*, *prominent below*; *intercostal venation densely scalariform*, *distinctly raised below*; *petiole 1–1.5 cm long*, *slender*. **Inflorescences** terminal or axillary; rachis to 8 cm long, singly branched, branchlets bearing to 6 flowers; bracteoles oblong, to 2 × 2 mm, obtuse. **Flowers:** buds ellipsoid, *to 5 × 3 mm*; sepals broadly ovate; *petals yellow*; *stamens 15*, *anthers 2-loculed*, *locules subglobose to broadly elliptic*, *connectival appendage aristate*, *sericeous*, *exceeding anther apice*; *ovary and stylopodium glabrous but for band of minute hairs towards apex*, *style equal to ovary and stylopodium*, *stigma not trifid*. **Fruits** subsessile; *calyx lobes unequal*, *3 longer lobes spatulate*, *to 6 × 1.3 cm*, *tapering to 3 mm above the tuberculate concave base*, *2 shorter ones to 4.5 × 0.8 cm*, *otherwise similar*. **Nuts** *narrowly ovoid*, *to 4.5 × 0.8 cm*, *densely pale rufous pubescent*.

Vernacular names. Sabah—*seraya kuning runcing* (preferred name). Sarawak—*lun runcing* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Beaufort, Kinabatangan, Sandakan, and Sipitang districts (e.g., *SAN 16942*, *SAN 17767*, *SAN 17953*, *SAN 37516*, and *SAN 70201*) and in Sarawak from Lawas district (e.g., *S 26560*). Also occurring in Brunei (e.g., *BRUN 3350* and *FMS 30404*).

Ecology. Locally frequent in mixed dipterocarp forest on friable sandy clay soils, on low hills at altitudes to 1600 m (near G. Murut). Vulnerable.

2. **Shorea acuta** P.S.Ashton

(Latin, *acutus* = sharp; the leaf tip)

(sect. **Mutica**, subsect. **Auriculatae**; red meranti)

Gard. Bull. Sing. 19 (1962) 268, *op. cit.* (1964) 174, *op. cit.* (1968) 104, *op. cit.* (1982) 533; Anderson *op. cit.* (1980) 124; Coode *et al.* (eds.) *op. cit.* 74; Newman *et al. op. cit.* (1996) 110. **Type:** *Mohsin S 1924*, Borneo, Brunei, Belait, Sg. Liang (holotype K; isotype KEP).

Small emergent tree, to 45 m tall, to 1 m diameter; buttresses stout. **Bark** *cracked and flaky becoming shallowly v-section fissured*, pale reddish brown; *inner bark plum-brown*, *densely fibrous*. *Young twig*, *inflorescence*, *leaf bud*, *parts of flower exposed in bud*, *petiole*, *venation below and midrib above shortly pale brown puberulent*; *glabrescent on leaf and fruit calyx*. **Twigs** *terete*, *to 4 mm diameter apically*, compressed at first, with non-amplexicaul stipule scars to 3 mm long. *Leaf buds ovoid*, *6–10 × 4–6 mm*, *acute*. **Stipules** *oblong*, *to 12 × 5 mm*, *obtuse*. **Leaves** *thickly coriaceous*, *shiny and scabrid-tomentose or glabrescent below*, *drying pale pinkish brown above*; *blade elliptic*, *14–26 × 6.5–12 cm*, *base equal or subequal*, *without domatia*, *obtuse or occasionally broadly cuneate*, *apex with* *tapering acumen to 2 cm long*; *midrib prominent below*, *narrowly slightly sunken above*; *lateral veins 10–13 pairs*, *prominent below*, *arched*; *intercostal venation densely scalariform*, *slender*, *sinuate*; *petiole 1.5–2 cm long*, *stout*. **Inflorescences** terminal or axillary; rachis compressed, to 8 cm long, singly or doubly branched, branchlets bearing to 9 flowers; bracteoles elliptic, to 3.5 × 2.5 mm, caducous. **Flowers:** buds narrowly ellipsoid, obtuse, to 9 × 4 mm; sepals subequal, ovate; *petals linear*, *dark crimson*; *stamens 15*, *filament flat*, *tapering from base to apex*, *connectival appendage aristate*, *not setose*, *at most of the same length as anther*, *becoming reflexed at anthesis*, *anther 4-loculed*, *locules broadly oblong to subglobose*; *ovary and distinct stylopodium pubescent*. **Fruits:** *calyx lobes unequal*, *3 longer lobes spatulate*, *obtuse*, *to 15 × 2.8 cm*, *tapering to 1.5 cm towards the narrowly auriculate base*, *2 shorter ones unequal*, *linear-lobed*, *to 8 × 0.7 cm*, *similar at base*. **Nuts** *ovoid*, *to 3 × 2 cm*, *acute*, *buff puberulent*.

Vernacular names. Sarawak—*engkabang tikus* (Iban), *kawang tikus* (Iban), *meranti kawang tikus* (Malay).

Distribution. Endemic in Borneo. Recorded in Sarawak from Limbang, Marudi and Miri districts (e.g., *S 1492*, *S 46478*, *S 46479*, *S 46482*, and *S 46591*). Also occurring in Brunei (e.g. *BRUN 3076*, *BRUN 3291*, *S 1906*, and *SAN 17474*). Conserved in the Lambir Hills NP and Mulu NP, Sarawak.

Ecology. Locally common in mixed dipterocarp forest on deep yellow sands, on hills at altitudes to 400 m. Endangered outside parks system.

3. **Shorea agamii** P.S.Ashton

(J. Agama, one-time forest officer in the Sabah Forest Department)

(sect. **Anthoshorea**, white meranti)

Gard. Bull. Sing. 19 (1962) 270, *op. cit.* (1964) 161, Gard. Bull. Sing. 22 (1967) 285, *op. cit.* (1968) 93, *op. cit.* (1982) 497; Meijer & Wood *op. cit.* 51; Burgess *op. cit.* 159; Anderson *op. cit.* (1980) 123; PROSEA *op. cit.* 409; Coode *et al.* (eds.) *op. cit.* 74; Newman *et al. op. cit.* (1996) 111. **Type:** *Smith FMS 30525*, Brunei, Labi Hills (holotype KEP).

Emergent tree, to 50 m tall, to 2 m diameter, with prominent stout buttresses. **Bark** becoming chocolate, ochreous and grey mottled, irregularly cracked and thickly flaky through surface rotting; inner bark distinctly laminated, orange-brown and cream-mottled. *Young twig*, *inflorescence*, *leaf bud*, *parts of perianth exposed in bud*, *ovary*, *stipule outside*, *petiole and midrib below pale brown puberulent*, *caducous*. **Twigs** *terete*, 2–3 mm diameter *apically*. Leaf buds ovoid to falcate, *c.* 4 × 2.5 mm. **Stipules** *oblong*, *obtuse*, *c. 10 × 3 mm*, *caducous*. **Leaves** *thickly coriaceous*, *drying tawny yellow with the venation the same shade*; *blade broadly ovate to oblong*, *10–15 × 6–10 cm* (subsp. *agamii*) or *narrowly ovate*, *4.5–10 × 2.5–4 cm* (subsp. *diminuta*), *base obtuse or subcordate*, *apex with broad acumen of 0.5–1 cm long*; *midrib prominent below*, *obscure*, *furrowed above as also the veins*; *lateral veins 9–13 pairs*, *well-spaced*, *arched*; *intercostal venation densely scalariform*; *petiole 1–1.5 cm long*. **Inflorescences** terminal or axillary; rachis to 10 cm long, branches short, bearing to 5 flowers; bracteoles elliptic, to 3 mm long, caducous. **Flowers:** buds narrowly ellipsoid, to 5 × 2.5 mm; sepals narrowly ovate, unequal; petals ovate-elliptic, acute, densely pubescent on exposed parts in bud; stamens 15, in 3 unequal whorls, filaments more or less as long as anthers, tapering gradually, anthers oblong, 4–loculed, connectival appendage *c.* 3x the length of anther; ovary ovoid, *without stylopodium*, densely pubescent, style slightly longer than ovary, sparsely pubescent in the basal half, stoutly filiform, obscurely trifurcate. **Fruits** *impressed at the c. 1 mm stout pedicel*; *calyx lobes unequal*, *3 longer lobes to 12 × 2.2 cm*, *tapering to c. 5 mm above the saccate base*, *2 shorter ones linear-lobed*, *unequal*, *to 6 × 0.4 cm*. **Nuts** *ovoid*, *to 2 × 1.5 cm*, *glabrescent*, *with acicular style remnant to 4 mm long*.

Vernacular names. Sabah—*melapi agama* (preferred name). Sarawak—*meranti putih timbul* (preferred name).

Distribution. Endemic in Borneo.

Ecology. Scattered in mixed dipterocarp forest on well-drained sandy clay soils, and clay-rich soils on ridges, at altitudes to 700 m.

Notes. Two subspecies, subsp. *agamii* and subsp. *diminuta*, are recognised.

Key to subspecies

Leaf blade broadly ovate to oblong, 10–15 × 6–10 cm……………………………………….. subsp. **agamii**

In Sabah known from Beaufort, Kudat, Sandakan, Sipitang, and Tawau districts (e.g., *SAN 18476* and *SAN 36222*) and in Sarawak from Lawas, Marudi and Miri districts (e.g., *S 1537* and *S 1936*). Also occurring in Brunei (e.g., *BRUN 3092* and *FMS 35449*) and E Kalimantan (e.g., *Ambriansyah Berau 1140* and *Meijer 2464*). Occurring in Lambir and Mulu NPs; elsewhere vulnerable following logging.

Leaf blade narrowly ovate, 4.5–10 × 2.5–4 cm………..…………………………………… subsp. **diminuta** P.S.Ashton

(Latin, *diminutus* = made small; the leaf)

Gard. Bull. Sing. 22 (1967) 285, *op. cit.* (1968) 93, *op. cit.* (1982) 497; PROSEA *op. cit.* 409; Newman *et al. op. cit.* (1996) 112. Type: *Sibat S 25027*, Borneo, Sarawak, Bt. Mersing, Anap (holotype K; isotype KEP).

Known in Sarawak from Kapit, Miri, Serian, Simunjan, and Tatau districts (e.g., *S 15227*, *S 23860*, *S 27005*, *S 36655*, and *S 46520*). Also occurring in W Kalimantan (e.g., *bb. 27005*, *bb. 29076* and *Wilkie 94313*). Ecology as the species. Vulnerable following logging. For differences from *S. confusa*, see there.

4. **Shorea albida** Symington Fig. 19.

(Latin, *albidus* = whitish; the leaf undersurface)

(sect. **Rubella**, red meranti)

Gard. Bull. S. S. 8 (1935) 283; Masamune *op. cit.* 492; Browne *op. cit.* 137; Anderson, Gard. Bull. Sing. 20 (1963) 158, *op. cit.* (1980) 74; Ashton *op. cit.* (1964) 175, *op. cit.* (1968) 104, *op. cit.* (1982) 499; PROSEA *op. cit.* 391. **Lectotype** (designated here)**:** *Zainal FMS 30353*, Borneo, Brunei, Kuala Belait (hololectotype KEP; isolectotype L).

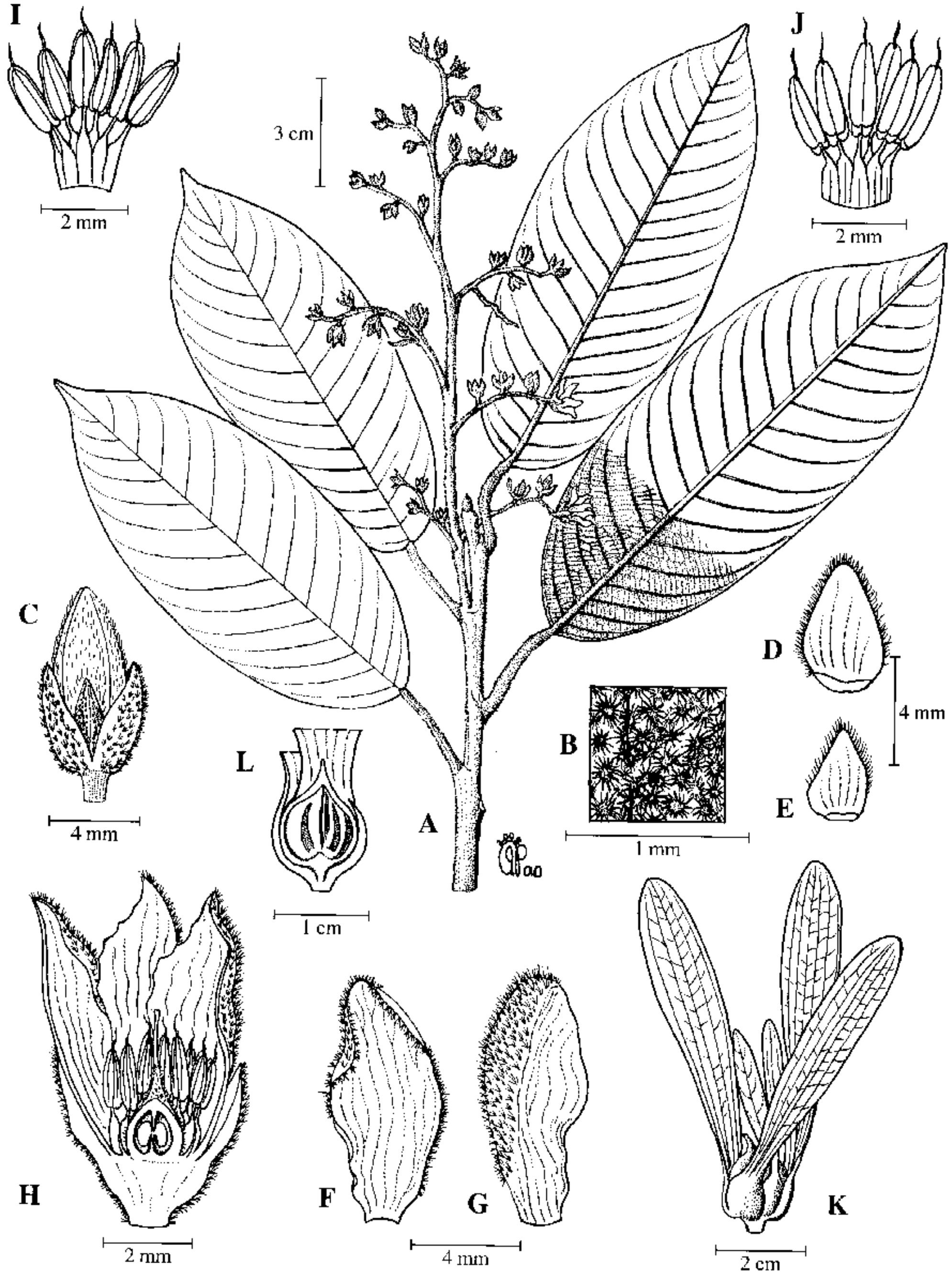

Fig. 19. *Shorea albida*. A, flowering leafy twig; B, detail of indumentum on the lower leaf surface; C, flower bud; D, outer sepal; E, inner sepal; F, adaxial view of petal; G, abaxial view of petal; H, longitudinal section of open flower; I, adaxial view of stamens; J, abaxial view of stamens; K, fruit; L, longitudinal section of fruit. (A–J from *S 651*, K–L from *S 2852*.)

Main canopy tree *c*. 30 m tall to giant emergent to 75 m tall, to 2.5 m diameter; crown vast, diffuse, sea-green; buttresses to 4 m tall and wide, stout. **Bark** becoming deeply v-section fissured, the surface eventually rotting off in irregular flakes; inner bark meat-red, fibrous, thick. **Heartwood** crimson red. *Twig*, *inflorescence*, *leaf bud*, *stipule and bracteole outside*, *parts of perianth exposed in bud*, *petiole and leaf venation below shortly densely persistently pinkish brown puberulent*; *leaf cream-lepidote below*. **Twigs** *compressed*, *to 5 × 2 mm apically*. *Leaf buds ovoid to hastate*, *compressed*, *acute*, *to 10 × 6 mm*. **Stipules** *oblong*, *obtuse*, *to 20 × 8 mm*, *caducous*. **Leaves** *coriaceous*, *drying greyish brown above*, *cream below with darker venation*; *blade oblong-elliptic*, 7.5–15 × 4.5–6.5 cm, *base obtuse*, *apex with tapering acumen to 6 m long*; *midrib obscure*, *sunken above*, *slender but prominent below*; *lateral veins 16–20 pairs*, *with shorter intermediates*, *slender*, *hardly elevated below*; *intercostal venation slender*, *densely scalariform*; *petiole 2–3.5 cm long*, *slender*. **Inflorescences** terminal or axillary; rachis compressed, lax, to 18 cm long, doubly branched, branchlets bearing to 3 flowers; bracteoles lanceolate, acute, to 8 × 3 mm. **Flowers:** buds broadly ellipsoid, to 9 × 5 mm, acute; sepals deltoid, unequal; petals ovate, cream; *stamens 20–25*, *filament broad at base*, *tapering gradually and filiform distally*, *anthers 4-loculed*, *locules narrowly oblong*, *longer than filament*, *connectival appendage glabrous*, *short*, *slender*, *erect*, *shorter than anther*; ovary without stylopodium, together with basal half of style pubescent, style 2x the length of ovary. **Fruits:** calyx lobes unequal, 3 longer lobes narrowly spatulate, to 8 × 1.4 cm, tapering to 4 mm above the saccate base, 2 shorter ones linear-lobed, to 3.5 × 0.4 cm. **Nuts** ovoid, to 1.2 × 0.9 cm, grey-buff puberulent, with to 2 mm filiform style remnant.

Vernacular name. Sarawak—*alan* (preferred name).

Distribution. Endemic in Borneo; known in Sarawak from Bintulu, Limbang Marudi, Miri, Serian, Sibu, and Sri Aman districts (e.g., *S 1253*, *S 2805*, *S 12250*, *S 13504*, and *S 13506*), Brunei (e.g., *BRUN 5009* and *FMS 37149*), and Lower Kapuas in W Kalimantan (e.g., *bb. 35243*).

Ecology. Formerly gregarious and dominant in three of the 'phasic communities' (PC) of the peat swamp forests (Anderson *op. cit.* 1963); from within the outermost mixed peat swamp forest, where this species reaches its greatest size in PC 2, the '*alan* forest', through PC 3, the '*alan bunga* forest', to PC 4, where it is shortest, the '*padang alan* forest'. The species seldom flowers and juveniles are rare, few surviving, except in the '*alan bunga* forest' where there is patchy regeneration; in '*padang alan*' forest the trees frequently topple, then shoot from epicormic branches forming new orthotrophic leaders. *Alan* forest individuals are generally hollow. Also occasional in poorly drained lower montane *kerangas* on Merurong Plateau, Bintulu district, at 800 m altitude. Occurring in Loagan Bunut and Mulu NPs. Critically endangered owing to failure to regenerate and conversion of the peat swamp forests.

5. **Shorea almon** Foxw.

(from a Philippine name—*almon*)

(sect. **Brachypterae**, red meranti)

Philip. J. Sci. 67 (1938) 313; Browne *op. cit.* 150; Meijer & Wood *op. cit.* 93; Burgess *op. cit.* 181; Ashton *op. cit.* (1968) 104, *op. cit.* (1982) 507; Anderson *op. cit.* (1980) 124; PROSEA *op. cit.* 291;

Newman *et al. op. cit.* (1996) 114. **Lectotype** (designated here**):** *Whitford FB 11647*, the Philippines, Cadiz, Negros Occidental (hololectotype K; isolectotype L).

Large emergent tree, to 70 m tall, to 1.2 m diameter; crown dense; bole tall, straight; buttresses to 2.5 m tall, 2 m wide, stout. **Bark** dark greyish brown, becoming vertically cracked and thinly flaked; inner bark pinkish brown, fibrous, hard. *Twig*, *inflorescence*, *bud*, *stipule and bracteole outside*, *parts of perianth exposed in bud*, *and leaf venation below more or less densely persistently pinkish brown scabrid-tomentose*; *stipule inside and venation above sparsely so*; *midrib above*, *nut and ovary evenly so.* **Twigs** *c.* 2 mm diameter apically. *Leaf buds ovate*, *compressed*, *acute*, *to 4 × 3 mm*. **Stipules** *lanceolate*, *acute*, *to 10 × 5 mm*, *caducous*. **Leaves** *chartaceous*, *somewhat concave*, *drying pinkish brown with the midrib and lateral veins typically distinctly paler*; *blade obovate-oblong*, *9–16 × 3.5–7 cm*, *base equal*, *broadly cuneate to obtuse*, *apex with short*, *broad acumen*, *to 0.8 cm long*; *midrib evident*, *flat or slightly furrowed above*, *slender but prominent below as also the veins*; *lateral veins 17–20 pairs*; *intercostal venation densely scalariform*, *elevated below*; *petiole slender*, *1–1.8 cm long.* **Inflorescences** terminal or axillary; rachis ascending, lax, to 20 cm long, singly branched, branchlets bearing to 10 flowers; bracteoles elliptic, to 5 × 3 mm, obtuse, not at first caducous. **Flowers:** buds lanceolate, to 7 × 3 mm; sepals unequal, deltoid to ovate; petals lanceolate, hirsute on exposed part in bud; stamens 15, in 3 unequal whorls, filaments compressed at base, abruptly tapering medially and filiform below the subglobose, 4-loculed anthers, connectival appendage slender, glabrous, *c.* 3x the length of anther; *ovary without distinct stylopodium*, *ovoid*, *style c. 1½*x *the length of ovary*, *filiform.* **Fruits:** pedicels to 3 mm long, prominent; calyx lobes unequal, 3 longer lobes to 14 × 2.5 cm, tapering to *c.* 8 mm above the saccate base, 2 shorter ones lorate-lobed, to 8 × 1 cm. **Nuts** ovoid, to 2 × 1.5 cm, shortly mucronate.

Vernacular name. Sabah—*seraya kerukup* (preferred name).

Distribution. Borneo and the Philippines. In Borneo, known in Sabah from Keningau, Kinabatangan, Lahad Datu, and Sandakan districts (e.g., *SAN 4472*, *SAN 23966*, *SAN 35632*, and *SAN 83424*) and in Sarawak from Bintulu, Lawas and Miri districts (e.g., *S 22576* and *S 24960*). Also occurring in Brunei (e.g., *FMS 35679* and *S 5792*) and NE Kalimantan (e.g., *Arifin et al. Berau 906*).

Ecology. Usually rare in mixed dipterocarp forest, on yellow clay soil over shale, on undulating land, at altitudes to 400 m. Rare in Lambir NP; endangered.

6. **Shorea alutacea** P.S.Ashton

(Latin, *alutaceus* = leather colour; the tomentum)

(sect. **Richetioides,** subsect. **Richetioides**, yellow meranti)

Gard. Bull. Sing. 22 (1967) 288, *op. cit.* (1968) 81, *op. cit.* (1982) 481; Anderson *op. cit.* (1980) 121; Newman *et al. op. cit.* (1996) 115. **Type:** *Bojeng S 10170*, Borneo, Sarawak, Lundu district, G. Gading NP (holotype K).

Medium-sized tree, to 1 m diameter; buttresses stout. **Bark** smooth; inner bark fibrous. *Twig*, *inflorescence*, *bracteole*, *parts of flower exposed in bud*, *ovary and nut*, *stipules*, *leaf bud*, *petiole and midrib shortly densely persistently tawny buff pubescent*; *leaf blade below sparsely so*; *fruit calyx sparsely caducously so.* **Twigs** *c.* 2 mm diameter apically, terete, sparsely branched, *with prominent stipule scars*. Leaf buds ovoid, acute, *c*. 2 × 1.5 mm, small. **Stipules** *narrowly deltoid*, *acute*, *to 8 × 3 mm*, *relatively large*. **Leaves** *chartaceous*, *drying pale greenish grey*, *wrinkling*; *blade ovate to lanceolate*, *15–22 × 6–8 cm*, *base cordate*, *apex with slender acumen to 1 cm long*; *midrib and veins furrowed above*, *slender but prominent below*; *lateral veins 14–19 pairs*; *intercostal venation slender*, *subscalariform*, *indistinct*; *petiole 0.6–1 cm long*, *0.2 cm diameter*, *rugose on drying*. **Inflorescences** terminal or axillary; rachis to 15 cm long, singly or doubly branched; bracteoles to 4 × 3 mm, ovate, acute, fugaceous. **Flowers:** *buds to 6 × 3 mm*; *stamens 15*, *anthers 2-loculed*, *locules subglobose*, *tapering abruptly medially*, *connectival appendage setose*, *3–4x the length of anther*; *ovary and stylopodium pyriform*. **Fruits:** pedicel *c*. 1 mm long; *calyx lobes unequal*, *3 longer lobes to 8 × 1.8 cm*, *tapering to 4 mm above the tuberculate narrowly saccate base*, *2 shorter ones to 6 × 1.2 cm*. **Nuts** *narrowly ovoid*, *to 2.2 × 1 cm*, *apiculate*.

Distribution. Locally endemic in the granodiorite mountains of W Sarawak; so far only known from G. Gading NP, Lundu district (e.g., *S 7975*, *S 7976* and the type), and the Bau limestone hills at Tiang Bekap, Kuching district (e.g., *S 32684*).

Ecology. In mixed dipterocarp forest on deep yellow clay loams, at altitudes below 300 m, apparently not common. Vulnerable.

7. **Shorea amplexicaulis** P.S.Ashton Fig. 20.

(Latin, *amplexicaulis* = stem-clasping; the petiole)

(sect. **Pachycarpae**, red meranti)

Gard. Bull. Sing. 19 (1962) 273, *op. cit.* (1964) 177, *op. cit.* (1968) 104, *op. cit.* (1982) 524; Meijer & Wood *op. cit.* 95; Burgess *op. cit.* 184; Anderson *op. cit.* (1980) 124; PROSEA *op. cit.* 392; Coode *et al.* (eds.) *op. cit.* 74; Newman *et al. op. cit.* (1996) 116. **Type:** *Ashton BRUN 3261*, Borneo, Brunei, Andulau FR (holotype K; isotype KEP).

Medium-sized emergent tree, to 50 m tall, to 1.2 m diameter, with stout low buttresses. **Bark** pale greyish brown, remaining smooth, hoop-marked; inner bark pale pinkish brown. **Heartwood** pink. *All exposed fleshy parts typically glabrous*, *but frequently sparsely caducous or persistently pale buff to golden pubescent.* **Twigs** slightly compressed at first, to 3 × 2 mm apically, *with prominent pale horizontal amplexicaul stipule scars. Leaf buds hastate*, *obtuse*, *10–15 × 3–5 mm*. **Stipules** *hastate*, *subacute*, *to 25 × 8 mm*, *not early caducous*. **Leaves** *coriaceous*, *drying dark crimson red often shiny below*, *paler pinkish brown above*; *blade elliptic*, 11–21 × 5–8 cm, *base cuneate*, *apex with tapering acumen to 1 cm long*; *midrib evident*, *flat above*, *terete and prominent below*; *lateral veins 9–12 pairs*, *arched*, *prominent below*; *intercostal venation remotely scalariform*, *distinct and slightly elevated below*; *petiole distinctly geniculate*, *1.5–2.5 cm long*. **Inflorescences** terminal or axillary; rachis lax, slender, compressed, to 24 cm long, singly branched, branchlets bearing to 11 distichous flowers; bracteoles lanceolate, to 13 × 8 mm, fugaceous. **Flowers:** buds to 10 × 3.5 mm; petals pale yellow; *anthers narrowly oblong*, *connectival appendage more than 2x the length of anther*; *ovary ovoid*, *glabrous*, *without distinct stylopodium*, *style columnar*. **Fruits** impressed at base; calyx generally glabrescent, lobes unequal, 3 longer lobes to 18 × 3 cm, tapering to 2 cm above the saccate base, 2 shorter ones to 13 × 0.8 cm, similar at base. **Nuts** broadly ovoid, acute, to 3.7 × 2.5 cm, persistently golden buff pubescent.

Vernacular names. Sabah—*kawang bukit* (preferred name). Sarawak—*engkabang pinang licin* (preferred name), *langgai* (Iban).

Distribution. Endemic in Borneo, occurring throughout the island except for the southwestern parts. In Sabah known from Beaufort, Sandakan and Tawau districts (e.g., *SAN 15106*, *SAN 22690*, *SAN 27397*, and *SAN 62919*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lawas, Limbang, Miri, and Simunjan districts (e.g., *S 164*, *S 10708*, *S 15840*, *S 23611*, *S 32240*, and *S 68171*). Also occurring in Brunei (e.g., *BRUN 3006* and *S 1633*) and Kalimantan (e.g., *bb. 29663*, *Church & Mahyar 1753* and *Jarvie and Ruskandi 5756*).

Ecology. In mixed dipterocarp forest, especially on clay-rich soils but also on sandy clay, at altitudes to 700 m. Not vulnerable.

Notes. Closely related to *S. beccariana* which differs in its golden tomentum, generally dull leaf undersurface and short ascending stipule scars. The two often occur together though *S. beccariana* ranges onto more sandy soils.

8. **Shorea andulensis** P.S.Ashton

(of Andulau FR in Brunei)

(sect. **Brachypterae**, red meranti)

Gard. Bull. Sing. 19 (1962) 275, *op. cit.* (1964) 178, *op. cit.* (1968) 105, *op. cit.* (1982) 514; Meijer & Wood *op. cit.* 97; Burgess *op. cit.* 184; Anderson *op. cit.* (1980) 124; Coode *et al.* (eds.) *op. cit.* 74; Newman *et al. op. cit.* (1996) 117. **Type:** *Ashton BRUN 3263*, Borneo, Brunei, Andulau FR (holotype K; isotypes KEP, L).

Medium-sized emergent tree, to 45 m tall, to 1.2 m diameter; crown pale from below, diffuse, hemispherical; buttresses stout, to 1 m tall. **Bark** becoming cracked and patchily flaky, pale pinkish brown mottled. *Twig*, *inflorescence*, *bracteole*, *leaf bud*, *parts of flower exposed in bud*, *stipule and petiole densely persistently yellowish buff-puberulent*, *more sparsely so on venation below and midrib above.* **Twigs** slender, at first compressed, 1.5–2 mm diameter apically. Leaf buds ovoid, compressed, 3–6 × 1.5–3 mm, subacute. **Stipules** *hastate*, *subacute*, *to 14 × 5 mm*. **Leaves** *thinly coriaceous*, *cream lepidote in mature tree*, *otherwise drying rich reddish brown below*, *pinkish brown above*; *blade elliptic-ovate*, *6–9 × 3–5 cm*, *base obtuse or broadly cuneate*, *margin undulate*, *apex with acumen to 0.8 cm long*; *midrib narrowly furrowed above*, *slender but prominent below as also the veins*; *lateral veins 10–13 pairs*, *straight and abruptly arched within margin*; *intercostal venation slender*, *scalariform*, *sinuate*; *petiole 1–1.2 cm long.* **Inflorescences** terminal or axillary; rachis terete or slightly compressed, to 12 cm long, singly or doubly branched, branchlets bearing to 10 flowers; bracteoles ovate, to 3 × 1.2 mm, subacute. **Flowers:** buds to 8 × 2.5 mm; calyx spreading; *petals lilac*; *stamens 15*, *connectival appendage c. 3x the length of anther*; *ovary small*, *ovoid*, *glabrous*, *stylopodium obscure*, *style c. 2x the length of ovary*, *columnar*, *pubescent in basal half.* **Fruits:** pedicels to 2 mm long; *calyx tube glabrescent*, *lobes unequal*, *3 longer lobes lorate*, *to 5 × 0.7 cm*, *base saccate*, *2 shorter ones to 3 cm long*, *otherwise similar.* **Nuts** *ovoid*, *to 3.5 × 2.5 cm*, *apiculate.*

Vernacular names. Sabah—*seraya daun merah* (preferred name). Sarawak—*meranti daun putih* (preferred name).

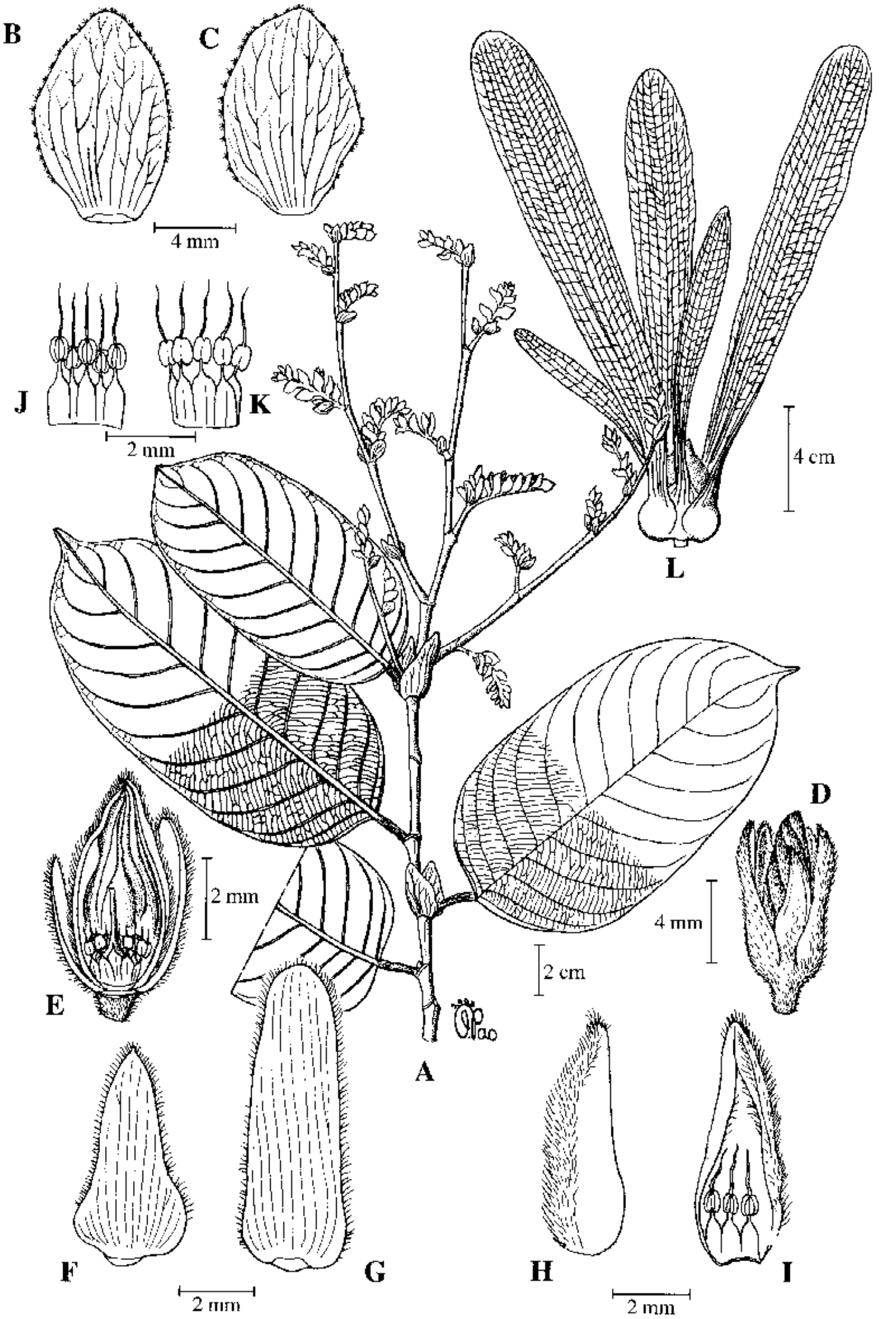

Fig. 20. *Shorea amplexicaulis.* A, flowering leafy twig; B, adaxial view of bract; C, abaxial view of bract; D, flower bud; E, flower bud with a few sepals and petals removed; F, adaxial view of inner sepal; G, adaxial view of outer sepal; H, abaxial view of petal; I, adaxial view of petal with 3 stamens; J, adaxial view of stamens; K, abaxial view of stamens; L, fruit. (A from *S 65194*, B–K from *S 29202*, L from *S 23611*.)

Distribution. Endemic in Borneo. In Sabah known from Kinabatangan and Labuk Sugut districts (e.g., *SAN 23264*, *SAN 99663* and *SAN 131981*) and in Sarawak from Bintulu, Kapit, Kuching, Lawas, and Limbang districts (e.g., *S 18408*, *S 22338*, *S 29580*, *S 32368*, and *S 44085*). Also occurring in Brunei (e.g., *BRUN 3030* and *BRUN 5435*) and W and E Kalimantan.

Ecology. Local and rare in mixed dipterocarp forest on yellow sandy clay soils, at altitudes to 600 m. In Sabah the species occurs in forest on ultrabasic substrates. Vulnerable.

9. **Shorea angustifolia** P.S.Ashton

(Latin, *angustus* = narrow, *folius* = leaf; with narrow leaves)

(sect. **Richetioides** subsect. **Richetioides**, yellow meranti)

Gard. Bull. Sing. 19 (1962) 277, *op. cit.* (1964) 150, *op. cit.* (1968) 81, *op. cit.* (1982) 478; Meijer & Wood *op. cit.* 67; Burgess *op. cit.* 217; Anderson *op. cit.* (1980) 121; Coode *et al.* (eds.) *op. cit.* 74; Newman *et al. op. cit.* (1996) 118. **Type:** *Ashton BRUN 778*, Borneo, Brunei, Kuala Temburong Macang (holotype K; isotypes KEP, L).

Main canopy tree, to 40 m tall, to 90 cm diameter, with frequently misshapen bole and low rounded buttresses. **Bark** becoming greyish tawny, thinly irregular flaky. *Twig endings and stipules sparsely caducous pale buff-brown puberulent*; *leaf bud*, *parts of flower exposed in bud*, *ovary and nut*, *inflorescence*, *bracteoles and petiole persistently so.* **Twigs** to 2 mm diameter apically, straight, terete, superficially cracked, rugose. Leaf buds small, ovoid, obtuse, to 0.5 × 1 mm. **Stipules** *linear*, *to 3 mm long*, *fugaceous*. **Leaves** *thinly coriaceous*, *drying pale greenish brown*; *blade deep violet when opening*, *ovate to oblong-lanceolate*, *8–14 × 2.5–4 cm*, *base cuneate*, *apex with tapering acumen to 1.5 cm long*; *midrib flat above*, *hardly elevated below as also the veins*; *lateral veins 8–10 pairs*, *well-spaced*, *arched*; *intercostal venation subscalariform*; *petiole 0.6–0.8 cm long*, *finely cracked and drying distinct pale brown to cream-grey.* **Inflorescences** terminal or axillary; rachis slender, lax, terete, to 10 cm long, singly or doubly branched, branchlets bearing to 8 flowers; bracteoles small, fugaceous. **Flowers:** buds to 2.5 × 1.5 mm, small; *petals cream*; *stamens 15*, *connectival appendage 1–2x the length of anther*; *ovary and stylopodium conical*, *style short*, *glabrous.* **Fruits:** *calyx lobes subequal*, *broadly ovate*, *obtuse*, *to 0.5 × 0.5 cm*, *incrassate and clasping the nut.* **Nuts** *obovoid*, *to 0.8 × 0.9 cm*, *acute*.

Vernacular names. Sabah—*seraya kuning bukit* (preferred name). Sarawak—*lun bukit* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Kota Kinabalu (Gaya Is.), Lahad Datu and Ranau (G. Kinabalu) districts (e.g., *KEP 80302*, *SAN 20704*, *SAN 24259*, *SAN 99630*, and *SAN 116969*) and in Sarawak from Belaga, Kapit and Lawas districts (e.g., *S 23309*, *S 25306*, *S 29484*, and *S 57667*). Also occurring in Brunei (e.g., *BRUN 3393*, *BRUN 5682* and *BRUN 5736*) and W and E Kalimantan (e.g., *bb. 29071*, *Kessler et al. Berau 888*, *Kostermans 5412*, and *Newman et al. 588*).

Ecology. Locally frequent on skeletal soils along shale ridges towards the upper limits of mixed dipterocarp forest, at 500–1200 m altitude. Occurring in Kinabalu and Mulu NPs; elsewhere becoming vulnerable.

10. **Shorea argentifolia** Symington Fig. 21.

(Latin, *argenteus* = silvery, *folius* = leaf; the silvery leaf undersurface)

(sect. **Mutica** subsect. **Mutica**, red meranti)

Gard. Bull. Sing. 17 (1960) 489; Ashton *op. cit.* (1964) 179, *op. cit.* (1968) 105, *op. cit.* (1982) 539; Meijer & Wood *op. cit.* 98; Burgess *op. cit.* 166; Anderson *op. cit.* (1980) 124; PROSEA *op. cit.* 392; Coode *et al.* (eds.) *op. cit.* 75; Newman *et al. op. cit.* (1996) 119. **Type:** *Maidin FMS 38838*, Borneo, Sabah, Tawau (holotype KEP).

Emergent tree, to 45 m tall, to 1.5 m diameter, with pale golden-suffused crown with pendent twig endings; buttresses to 1.5 m tall, stout. **Bark** becoming v-section fissured, pinkish brown; inner bark and heartwood pinkish brown. *Twig endings*, *inflorescence*, *leaf bud*, *parts of flower exposed in bud*, *nut*, *stipule*, *bracteole*, *petiole*, *leaf blade below*, *and midrib above persistently densely pinkish golden velutinous*; *fruit calyx shortly sparsely pubescent*. **Twigs** at first compressed, *c.* 2 × 1 mm apically, sparingly branched; stipule scars obscure. *Leaf buds ovoid*, *slightly compressed*, *subacute*, *c. 4 × 2.5 mm*. **Stipules** *oblong-hastate*, *to 20 × 7 mm*, *acute*, *cordate*, *not early caducous*. **Leaves** *thinly coriaceous*, *drying pinkish brown below*, *pale mauve-brown above*; *blade oblong-lanceolate*, *6–11 × 2.5–4.5 cm*, *base obtuse*, *apex with acumen c. 0.5 cm long*; *midrib narrowly sunken above*, *terete*, *slender but prominent below as also the veins*; *lateral veins 20–25 pairs*, *dense with short intermediates*; *intercostal venation slender*, *densely scalariform*; *petiole 0.8–1 cm long*, *relatively short*, *rugose.* **Inflorescences** terminal or axillary; rachis compressed, to 12 cm long, singly branched, branchlets bearing to 6 flowers; bracteoles oblong-elliptic, obtuse, to 8 × 3.5 mm, caducous. **Flowers:** buds to 6 × 3 mm; *petals pink*; stamen 15, *connectival appendage short*, *hardly or not reflexed*; ovary and stylopodium pyriform, short-pubescent, style as long as ovary, glabrous. **Fruits:** calyx lobes unequal, 3 longer lobes to 8 × 1.2 cm, tapering to 4 mm above the saccate base, 2 shorter ones unequal, linear-lobed, to 3 × 0.15 cm, similar at base. **Nuts** ovoid, to 1.4 × 0.9 cm, with to 2.5 mm long acicular style remnant.

Vernacular names. Sabah—*seraya daun perak* (preferred name). Sarawak—*meranti binatoh* (preferred name).

Distribution. Endemic in Borneo. Known in Sabah from Beaufort, Keningau, Kinabatangan, Lahad Datu, Labuk Sugut, Ranau, Sandakan, and Tawau districts (e.g, *SAN 16976*, *SAN 23972*, *SAN 55561*, *SAN 77288*, and *SAN 99224*) and in Sarawak from Belaga, Bintulu, Kapit, Lawas, Limbang and Miri districts (e.g., *S 15564*, *S 29660*, *S 32224*, and *S 69132*). Also occurring in Brunei (e.g., *BRUN 126*, *FMS 28661* and *FMS 30534*) and NE Kalimantan (pers. obs.).

Ecology. Locally frequent in mixed dipterocarp forest on clay rich alluvium soils, on hill slopes and sometimes ridges, at altitudes to 900 m. Occurring in Lambir and Mulu NPs; elsewhere vulnerable owing to forest conversion.

11. **Shorea asahii** P.S.Ashton

(Asah Unyong, *c.* 1938–, Sarawakian tree climber and dendrologist extraordinaire)

(sect. **Shorea** subsect. **Barbata**, *selangan batu*)

Gard. Bull. Sing. 19 (1962) 279, *op. cit.* (1964) 128, *op. cit.* (1968) 68, *op. cit.* (1982) 463; Meijer & Wood *op. cit.* 163; Burgess *op. cit.* 202; Anderson *op. cit.* (1980) 118; Coode *et al.* (eds.) 75; Newman *et al. op. cit.* (1998) 169. **Type:** *Flemmich FMS 37183*, Borneo, Brunei, Tutong district, Bt. Bedawan (holotype KEP).

Low emergent tree, to 40 m tall, to 90 cm diameter, with frequently misshapen bole and low thin buttresses to 80 cm tall. **Bark** surface becoming dark greyish brown mottled, cracked and thinly flaky. *Young parts at first shortly puberulent, otherwise glabrous but for densely persistently cream-buff puberulent inflorescence; parts of flower exposed in bud, ovary, nut, and fruit calyx sparsely so.* **Twigs** *c.* 0.7 mm diameter apically, slender, much-branched, terete. Leaf buds falcate, to 1.5 × 1 mm, small. **Stipules** narrowly deltoid, to 5 mm long, fugaceous. **Leaves** *coriaceous, lustrous; blade ovate, 6–10 × 3–5 cm, base subequal, broadly cuneate, apex with slender acumen c. 1 cm long; midrib hardly raised; lateral veins 6–7 pairs, arched, slender, unraised on either surface; intercostal venation densely scalariform, unraised, obscure; petiole c. 1 cm long, slender.* **Inflorescences** terminal or axillary; rachis slender, terete, to 2 cm long, singly branched, branchlets zig-zag, bearing to 4 close flowers; bracteoles elliptic, to 2 mm, fugaceous. **Flowers:** buds globose, to 2 mm diameter; *stamens c. 30, filaments, anthers and connectival appendage sparsely barbate distally, appendage to 2x the length of anther*; ovary and stylopodium ovoid, densely pubescent, style short, slender, glabrous. **Fruits:** *calyx lobes subequal, ovate, to 0.4 × 0.4 cm, subacute, appressed to nut.* **Nuts** *oblong-ovoid, to 1.1 × 0.6 cm, acute.*

Vernacular names. Sabah—*selangan batu asah* (preferred name). Sarawak—*kumus bukit* (Iban).

Distribution. Endemic in Borneo. In Sabah known from the Crocker Range (e.g., *SAN 24279*) and in Sarawak from Kapit, Limbang, Lubok Antu, and Miri districts (e.g., *SA 690*, *S 29561*, *S 41410*, and *S 57238*). Also occurring in Brunei (e.g., *BRUN 772*, *BRUN 5632* and *S 1183*) and W Kalimantan (e.g., *bb. 35219* and *bb. 35220*).

Ecology. Very rare, in the lower limits of upper dipterocarp forest, on thinly organic skeletal soils over shale and sandstone on minor peaks and spurs, usually at 650–850 m altitude. Recorded from Lambir NP, elsewhere endangered.

12. **Shorea atrinervosa** Symington Fig. 22.

(Latin, *ater* = dull black, *nervosus* = nerved; the leaf venation drying black)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

Gard. Bull. S. S. 10 (1939) 363, *op. cit.* (1943) 9; Masamune *op. cit.* 492; Browne *op. cit.* 167; Meijer & Wood *op. cit.* 163; Burgess *op. cit.* 202, 210; Ashton *op. cit.* (1968) 68, *op. cit.* (1982) 457; Anderson *op. cit.* (1980) 118; PROSEA *op. cit.* 427; Coode *et al.* (eds.) *op. cit.* 75; Newman *et al. op. cit.* (1998) 170. **Type:** *Alwi FMS 31832*, Peninsular Malaysia, Pahang, Bt. Goh FR (holotype KEP).

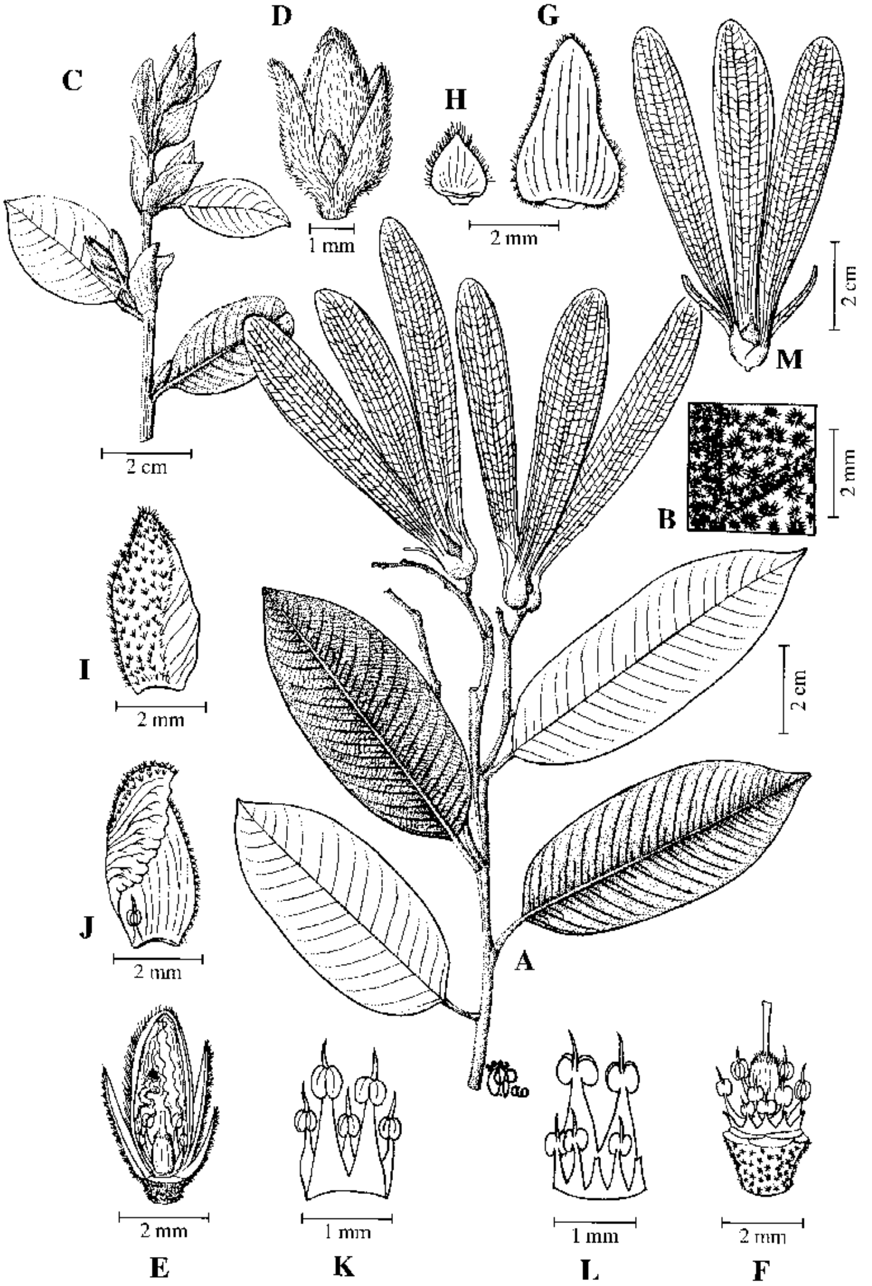

Fig. 21. *Shorea argentifolia*. A, fruiting leafy twig; B, detail of indumentum on the lower leaf surface; C, young shoot with stipules, bracts and young inflorescence; D, flower bud; E, flower bud with exposed gynoecium; F, gynoecium and stamens; G, adaxial view of outer sepal; H, adaxial view of inner sepal; I, abaxial side of petal; J, adaxial side of petal; K, adaxial view of stamens; L, abaxial view of stamens; M, fruit. (A–B from *S 15564*, C–L from *SAN 55561*, M from *SAN 99224*.)

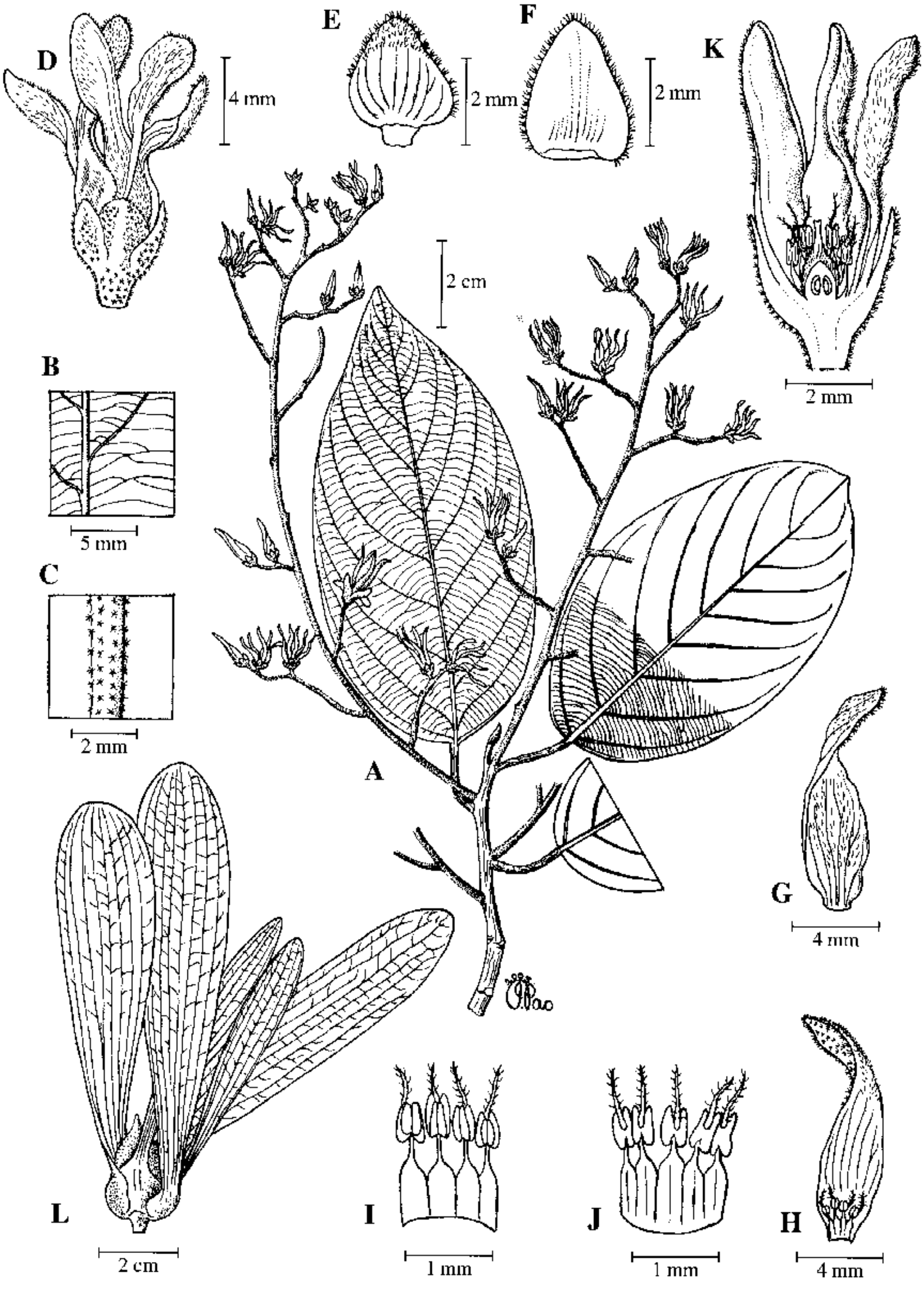

Fig. 22. *Shorea atrinervosa.* A, flowering leafy twig; B, detail of venation on lower leaf surface; C, detail of indumentum on midrib; D, open flower; E, adaxial view of outer sepal; F, adaxial view of inner sepal; G, abaxial side of petal; H, adaxial side of petal with stamens; I, adaxial view of stamens; J, abaxial view of stamens; K, longitudinal section of open flower; L, fruit. (A–C from *SAN 15091*, D–K from *SAN 27274*, L from *SAN 16957*.)

Large emergent tree, to 50 m tall, to 1.2 m diameter, with pale diffuse somewhat irregular crown; bole tall and straight; buttresses to 3 m tall, thin, spreading. **Bark** tawny-brown, irregularly oblong-flaky. *Bud*, *twig and petiole fugaceous puberulent*; *stipules*, *inflorescences*, *parts of perianth exposed in bud*, *ovary*, *and nut*, *persistently so*; *parts otherwise glabrous.* **Twigs** *c.* 2 mm diameter apically, terete, *drying black*, *becoming ribbed.* Leaf buds narrowly ovoid, acute, to 4 × 2 mm. **Stipules** lanceolate, to 8 × 3 mm acute, caducous. **Leaves** *thinly coriaceous*, *undulate*, *more or less white lepidote below* (in mature trees) *with the veins drying distinct black*; *blade elliptic to ovate*, *frequently of irregular shape*, 8–16 × 3.5–9 cm, *base broadly cuneate to subcordate*, *apex with tapering acumen to 1 cm long*; *midrib elevated above*, *prominently so below*; *lateral veins 10–12 pairs*, *stout and elevated below*, *often somewhat sinuous*, *sometimes with small glabrous domatia*; *intercostal venation scalariform*, *slender*, *sinuous*; *petiole at first whitish lepidote*, *drying black*, *1.2–2.2 cm long*, *geniculate.* **Inflorescences** terminal or axillary; rachis straight, terete, to 11 cm long, singly branched, branchlets bearing to 6 secund flowers; bracteoles elliptic, to 3 × 2 mm, acute. **Flowers:** buds to 8 × 3 mm; *petals cream with crimson median stripe towards base*; *stamens 25–33*, *filaments sparsely setose*, *outer anther locules glabrous*, *connectival appendage as long as anther*, *setose*; ovary and stylopodium ovoid, pubescent, surmounted by a short, glabrous style. **Fruits:** pedicels to 4 mm long, broadening into fruit base; *calyx lobes unequal*, *longer lobes to 11 × 2.5 cm*, *tapering to 1 cm above the saccate base*, *2 shorter ones lorate-lobed*, *to 8.5 × 0.9 cm*. **Nuts** *ellipsoid*, *to 2.5 × 2 cm*, *tapering into to 8 mm stout style remnant*.

Vernacular name. Sabah and Sarawak—*selangan batu hitam* (preferred name).

Distribution. Peninsular Malaysia, Sumatra and Borneo. In Sabah known from Beaufort, Kinabatangan, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Sipitang, Tawau, and Tenom districts (e.g., *SAN 15041*, *SAN 15262*, *SAN 16595*, *SAN 24258*, and *SAN 72287*) and in Sarawak from Bintulu, Kapit, Kuching, Lawas, Lundu, Marudi, Mukah, Simunjan, and Tatau districts (e.g., *S 15215*, *S 19570*, *S 22830*, *S 24698*, and *S 57601*). Also occurring in Brunei (e.g., *BRUN 3337* and *BRUN 3342*) and W and E Kalimantan (e.g., *bb. 23517*, *Kessler et al. Berau 793* and *Kostermans 13890*).

Ecology. Scattered, locally frequent in mixed dipterocarp forest on clay-rich soils on low hills and moist valleys, at altitudes to 600 m. Occurring in Lambir and Mulu NPs; elsewhere vulnerable.

13. **Shorea bakoensis** P.S.Ashton

(of Bako NP, Sarawak)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. Sing. 22 (1967) 289, *op. cit.* (1968) 81, *op. cit.* (1982) 479; Anderson *op. cit.* (1980) 121; Newman *et al. op. cit.* (1996) 121. **Type:** *Brunig S 17502*, Borneo, Sarawak, Bako NP (holotype K).

Subcanopy or low canopy tree, recorded to 7 m tall, to 5 cm diameter. **Bark** smooth. *All observed parts glabrous but for the sericeous fruit calyx outside, and densely buff-pubescent nut.* **Twigs** *c.* 2 mm diameter apically, terete, drying black. Buds and stipules unknown. **Leaves** *thickly coriaceous*, *drying dark tawny brown*, *shiny below*; *blade narrowly oblong to lanceolate*, *13–18 × 5–6 cm*, *base obtuse*, *apex with slender acumen to 1 cm long*; *midrib evident but flat above*, *prominent below*; *lateral veins 9–10 pairs*, *prominent below*;

intercostal venation subscalariform, *hardly raised below*; *petiole 1–1.2 cm long*, *stout*, *drying black*. **Inflorescences** and **flowers** unknown. **Fruits:** pedicels short; *calyx lobes subequal*, *oblong*, *obtuse*, *incrassate*, *clasping the nut*. **Nuts** *ellipsoid-cylindric*, *to 2.5 × 1.4 cm*, *apiculate*.

Distribution. Endemic in Borneo; rare and localised, known only by a single collection (the type) from Bako NP but also observed at G. Santubong, Kuching district, Sarawak, at altitudes below 200 m.

Ecology. In *kerangas* forest on shallow podsols on sandstone ridges and plateaux. Rare and possibly endangered.

14. **Shorea balanocarpoides** Symington

(Greek, resembling *Balanocarpus*; the fruit resembles that of *Neobalanocarpus*, a genus endemic in Peninsular Malaysia)

(sect. **Richetioides** subsect. **Richetioides**, yellow meranti)

Gard. Bull. S. S. 9 (1938) 330, *op. cit.* (1943) 47; Slooten, Reinwardtia 3 (1956) 340; Ashton *op. cit.* (1982) 475; PROSEA *op. cit.* 418; Coode *et al.* (eds.) *op. cit.* 75; Newman *et al. op. cit.* (1996) 123. **Type:** *Lambak FMS 15768*, Peninsular Malaysia, Pahang, Rompin (holotype KEP). **Synonyms:** *Balanocarpus pahangensis* Foxw., Malay. For. Rec. 10 (1932) 145; *Shorea dolichocarpa* Slooten *op. cit.* (1956) 342, Ashton *op. cit.* (1964) 151, *op. cit.* (1968) 83, Anderson *op. cit.* (1980) 121.

Main canopy tree, to 40 m tall, to 80 cm diameter; bole frequently misshapen; buttresses to 1 m tall, stout. **Bark** tawny brown, cracked and irregularly flaky. *Young twig*, *leaf bud*, *stipule outside*, *inflorescence*, *and flower calyx outside sparsely greyish puberulent*; *parts of petals exposed in bud*, *ovary and stylopodium persistently so*; *nut densely mauve-grey pubescent*. **Twigs** *c.* 1.5 mm diameter apically, terete, much-branched. Leaf buds small, globose to ovoid, obtuse, to 2 × 1.5 mm. **Stipules** linear, fugaceous, to 4 mm long. **Leaves** *coriaceous*, *drying tawny-brown*; *blade ovate*, *6–12 × 2–7 cm*, *base obtuse to cuneate* (*narrowly peltate in juveniles*), *decurrent to 1.5 mm down petiole*, *usually unequal*, *apex with slender acumen*, *to 1 cm long*; *midrib stout on both surfaces*, *somewhat elevated above*, *raised below*; *lateral veins 5–7 pairs*, *arched*, *widely spaced*, *raised below*; *intercostal venation more or less reticulate to scalariform towards margin*, *distant*, *elevated below*; *petiole 1.2–2 cm long*. **Inflorescences** terminal or axillary; rachis slender, to 8 cm long, somewhat irregularly doubly branched, branchlets often zig-zag, bearing to 8 distichous flowers; bracteoles minute, fugaceous. **Flowers:** buds to 4.5 × 1.2 mm; petals yellowish brown with bright yellow margin; *stamens 15*, *connectival appendage ciliate towards apex*; *ovary and stylopodium subglabrous*. **Fruits** subsessile; *calyx lobes subequal*, *deltoid*, *c. 0.5 × 0.5 cm*, *subrevolute at margins*, *appressed to the nut*. **Nuts** *ellipsoid to obovoid*, *to 3 × 1.3 cm*, *acute*, *mauve-grey pubescent*.

Vernacular names. Sarawak—*barek* (Iban), *lun gondol* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. Not yet reported from Sabah. In Sarawak known from Belaga, Bintulu, Kapit, Limbang, and Miri districts (e.g., *S 15139*, *S 29244*, *S 32358*, *S 42977*, and *S 57655*). Also occurring in Brunei (e.g., *BRUN 3003* and *BRUN 3365*).

Ecology. Local, but there often common, in mixed dipterocarp forest, on clay and sandy clay soils, particularly on slopes, at altitudes to 700 m. Vulnerable.

15. **Shorea beccariana** Burck

(Odoardo Beccari, 1843–1920, Italian explorer and botanist)

(sect. **Pachycarpae**, red meranti)

Ann. Jard. Bot. Buitenz. 6 (1887) 213; Merrill, EB (1921) 404; Browne *op. cit.* 138; Ashton, Gard. Bull. Sing. 20 (1963) 280, *op. cit.* (1964) 180, *op. cit.* (1968) 105, *op. cit.* (1982) 525; Meijer & Wood *op. cit.* 100; Burgess *op. cit.* 154, 182; Anderson *op. cit.* (1980) 125; PROSEA *op. cit.* 393; Coode *et al.* (eds.) *op. cit.* 75; Newman *et al. op. cit.* (1996) 124. **Lectotype** (designated here)**:** *Beccari PB 1127*, Borneo, 'Sarawak' (hololectotype BO). **Synonym:** *Shorea franchetiana* F.Heim, *op. cit.* (1891) 956.

Emergent tree, to 60 m tall, to 1.1 m diameter; crown often golden-suffused from below; bole tall, often somewhat sinuate; buttresses to 1.5 m tall, stout. **Bark** smooth, hoop-marked, occasionally somewhat flaky in large trees; inner bark pinkish brown; heartwood pink. *Young twig*, *inflorescence*, *parts of perianth exposed in bud*, *leaf bud*, *stipule*, *and petiole evenly densely rufous-brown puberulent*, *turning mauve-grey*, *sparsely so on venation below*; *nut buff pubescent.* **Twigs** compressed, 3–6 × 1–2.5 mm apically, dull greyish brown; *stipule scars shortly cuneate to falcate*, *more or less ascending*. Leaf buds hastate, compressed, acute, 7–11 × 3.5–4.5 mm. **Stipules** *oblong*, *obtuse*, *small*, *to 14 × 5 mm*, *caducous*. **Leaves** *coriaceous*, *golden lepidote turning to dull mauve-grey below* (in mature trees); *blade elliptic to ovate*, *11–20 × 5.5–7 cm*, *base obtuse or broadly cuneate*, *apex with broad acumen to 0.8 cm long*; *midrib prominent below*, *evident albeit shallowly sunken above*; *lateral veins 11–14 pairs*, *arched*, *slender but elevated below* (more prominent in immature trees); *intercostal venation remotely scalariform*; *petiole 2–4 cm long*. **Inflorescences** terminal or axillary; rachis lax, more or less compressed, to 20 cm long, singly branched, branchlets bearing to 8 distichous flowers; bracteoles oblong, obtuse, to 15 × 9 mm, caducous. **Flowers:** buds to 9 × 3 mm; petals pink; stamens 15, connectival appendage 2–3x the length of anther; stylopodium and style cylindrical. **Fruits:** base frequently impressed; calyx glabrescent, *lobes unequal*, *3 longer lobes to 19 × 2.7 cm*, *tapering to 1.2 cm above the saccate base*, *2 shorter ones linear-lobed*, *to 10.5 × 0.9 cm*, *similar at base*. **Nuts** *broadly ovoid*, *to 4 × 2.8 cm*; *style remnant conical*, to 4 mm long.

Vernacular names. Sabah—*seraya langgai* (preferred name). Sarawak—*langgai* (Iban), *meranti langgai* (preferred name).

Distribution. Endemic in Borneo. Common and known in Sabah from Labuk Sugut, Sandakan, Sipitang, Tawau, and Tenom districts (e.g., *SAN 16023*, *SAN 16468*, *SAN 27397*, *SAN 35898*, and *SAN 97628*) and in Sarawak from Bintulu, Kapit, Kuching, Limbang, Lundu, and Miri districts (e.g., *S 10125*, *S 12612*, *S 27129*, *S 32308*, and *S 46476*). Also occurring in Brunei (e.g., *BRUN 418*, *BRUN 3187*, *Niga NN 225*, *S 1933*, and *S 2172*) and W and NE Kalimantan (e.g., *bb. 27726*, *bb. 30208*, *Newman et al. 585*, and *Suzuki K 9494*).

Ecology. One of the commonest trees in mixed dipterocarp forest on well-drained sites, on yellow sandy and sandy clay soils, and on well-drained shale ridges, at altitudes to 700 m. Occurring in Bako, Lambir and Mulu NPs; not vulnerable.

Notes. For comparison with *S. amplexicaulis*, see there.

16. **Shorea biawak** P.S.Ashton

(*biawak* = the monitor lizard, whose skin the bark resembles)

(sect. **Shorea** subsect. **Barbata**, *selangan batu*)

Gard. Bull. Sing. 19 (1962) 281, *op. cit.* (1964), *op. cit.* (1968) 68, *op. cit.* (1982) 464; Meijer & Wood *op. cit.* 165; Burgess *op. cit.* 202; Anderson *op. cit.* (1980) 118; Coode *et al.* (eds.) *op. cit.* 75; Newman *et al. op. cit.* (1998) 171. **Type:** *Ashton BRUN 3369*, Borneo, Brunei, Bangar (holotype K; isotype KEP).

Main canopy tree, to 35 m tall, to 70 cm diameter, with straight bole and low thin buttresses. **Bark** *overall remaining smooth*, *but patterned by dense minute zig-zag v-section surface fissures*. **Twigs** *c.* 1 mm diameter apically, slender, terete, much-branched, smooth and striated. *Young twig*, *leaf bud*, *parts of perianth exposed in bud*, *ovary*, *nut*, *inflorescence*, *and petiole more or less densely pale buff-puberulent*, *persistent only on inflorescence*, *bud and ovary*. Leaf buds to 1 mm long, small. **Stipules** unknown. **Leaves** *thinly coriaceous*, *drying pale greyish brown*; *blade ovate*, *6–10 × 2.5–4.5 cm*, *base obtuse or broadly cuneate*, *apex subcaudate*, *acumen to 1.5 cm long*; *midrib slender*, *somewhat elevated below*, *flat or slightly elevated above*; *lateral veins slender*, *5–6 pairs*, *arched and ascending*, *elevated below*, *slightly furrowed above*, *with small puberulent domatia*; *intercostal venation densely scalariform*, *not raised*; *petiole 0.7–1 cm long*, *slender*. **Inflorescences** terminal or axillary; rachis terete, to 14 cm long, singly branched, branchlets densely bearing to 6 flowers; bracteoles ovate, acute, to 2 mm long, fugaceous. **Flowers:** buds globose, to 1.5 mm diameter; petals cream-white; *stamens c. 35*, *filaments glabrous*, *anthers sparsely barbate apically*, *connectival appendage slightly shorter than anther*, *densely barbate*; ovary and stylopodium ovoid to pyriform, densely pubescent, style short, glabrous. **Fruits:** *calyx lobes subequal*, *suborbicular*, *obtuse*, *appressed to nut*, *to 0.7 × 0.9 cm*. **Nuts** *subglobose*, *to 1.3 × 1 cm*, *obtuse with apiculate style remnant to 1.5 mm long*.

Vernacular names. Sabah—*selangan batu biawak* (preferred name). Sarawak—*resak biawak* (Iban), *selangan batu biawak* (preferred name).

Distribution. Endemic in Borneo. Known in Sabah from Beaufort district (e.g., *SAN 15068*, *SAN 24825* and *SAN 26567*) and in Sarawak from Bintulu, Kapit and Miri districts (e.g., *S 14453*, *S 28778* and *S 31711*). Also occurring in Brunei (e.g., *BRUN 3005* and *BRUN 3351*).

Ecology. Widespread but apparently rare, easily overlooked, in mixed dipterocarp forest on clay soils, at altitudes to 600 m. Present in Lambir NP; elsewhere vulnerable.

17. **Shorea bracteolata** Dyer

(Latin, *bracteolatus* = with bracteoles; the persistent bracteoles of the inflorescence)

(sect. **Anthoshorea**, white meranti)

Fl. Brit. Ind. 1 (1874) 305; Masamune *op. cit.* 493; Slooten, Bull. Jard. Bot. Buitenz. 3, 18 (1949) 259; Browne *op. cit.* 158; Ashton *op. cit.* (1964) 163, *op. cit.* (1968) 93 & 496, *op. cit.* (1982) 496; Meijer & Wood *op. cit.* 53; Burgess *op. cit.* 159; Anderson *op. cit.* (1980) 123; PROSEA *op. cit.* 410; Coode *et al.* (eds.) *op. cit.* 75; Newman *et al. op. cit.* (1996) 125. **Type:** *Maingay 204*, Peninsular Malaysia, Malacca (holotype K; isotype L).

Emergent tree, to 50 m tall, to 1.2 m diameter; bole straight; crown large, hemispherical, dense; buttresses to 1.2 m tall, stout. **Bark** surface pale chocolate-brown, becoming cracked and rather thinly irregularly flaky; inner bark laminated pale and dark brown. *All parts at first sparsely pale brown puberulent, surfaces waxy scurfy; glabrescent except on inflorescence, buds and ovary.* **Twigs** *c.* 2 mm diameter apically, somewhat compressed. Leaf buds shortly falcate, compressed, subacute, 3–5 × 2 mm. **Stipules** *linear, c. 10 mm long, fugaceous.* **Leaves** *chartaceous or thinly coriaceous, drying dull greyish brown; blade oblong-ovate to elliptic, 9–14 × 4–6 cm, base obtuse, apex with tapering acumen to 1.5 cm long; midrib obscurely sunken above, slender but prominent below; lateral veins slender, 12–15 pairs, arched; intercostal venation distantly scalariform to subreticulate; petiole 1–2 cm long, slender.* **Inflorescence** terminal or axillary; rachis slender, straight, terete, to 10 cm long, singly branched, branchlets bearing to 5 flowers; bracteoles lanceolate, to 12 × 5 mm, not early caducous. **Flowers:** buds to 10 × 5 mm; *petals pale yellow tinged pink at base within; stamens 15, anthers narrowly oblong, connectival appendage 3–4x the length of anther, scabrous; ovary ovoid, scabrous apically without stylopodium, style c. 2x the length ovary.* **Fruits:** calyx glabrescent; lobes unequal, 3 longer lobes to 10 × 1.7 cm, tapering to 4 mm above the saccate base, 2 shorter ones unequal, to 8 × 0.7 cm. **Nuts** narrowly ovoid, to 2 × 1 cm, with filiform style remnant to 4 mm long.

Vernacular names. Sabah—*melapi pa'ang* (preferred name). Sarawak—*meranti pa'ang* (preferred name).

Distribution. Sumatra, Peninsular Malaysia, Singapore, and throughout Borneo. In Sabah known from Lahad Datu and Tawau districts (e.g., *SAN 17832*, *SAN 22651*, *SAN 31227*, *SAN 39093*, and *SAN 54885*) and in Sarawak from Kuching, Lawas and Lundu districts (e.g., *S 10705*, *S 15199*, *S 32443*, and *S 40580*). Also occurring in Brunei (e.g., *BRUN 907* and *Dransfield JD 6662*) and Kalimantan (e.g., *bb. 14612*, *bb. 27691*, *Kostermans 6354*, and *Kostermans 13329*).

Ecology. In mixed dipterocarp forest on well-drained clay and sandy soils. Mostly scattered and often uncommon, but locally frequent on coastal hills, at altitudes to 700 m. Vulnerable.

18. **Shorea brunnescens** P.S.Ashton

(Latin, *brunnescens* = brownish; the dry leaf)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

Gard. Bull. Sing. 22 (1967) 283, *op. cit.* (1968) 68, *op. cit.* (1982) 449; Anderson *op. cit.* (1980) 119; Newman *et al. op. cit.* (1998) 172. **Type:** *Smythies S 15218*, Borneo, Sarawak, Simunjan districts, Bt. Gaharu (holotype K; isotypes KEP, L).

Emergent tree, to 45 m tall, to 1.2 m diameter; bole straight, buttresses to 1.2 m tall, thin. **Bark** becoming vertically cracked and thinly oblong-flaky, pale tawny-brown. *Leaf bud, parts of perianth exposed in bud, ovary, and nut densely more or less persistently buff-pubescent; inflorescence, young twig and petiole sparsely caducously so.* **Twigs** *c.* 1 mm diameter apically, terete. Leaf buds small, ovoid, acute, to 2.5 × 2 mm. **Stipules** not seen. **Leaves** *coriaceous*, *drying pale ochreous-brown*; *blade broadly ovate to lanceolate*, *6–12 × 2.5–6 cm*, *base broadly cuneate*, *apex with narrow acumen to 1 cm long*; *midrib obscure*, *furrowed above*, *slender but prominent below*; *lateral veins 9–11 pairs*, *slender*, *arched*, *barely elevated below*; *intercostal venation dense*, *subreticulate*, *hardly raised but evident below*; *petiole 1–1.5 cm long*, *subgeniculate*. **Inflorescences** terminal or axillary; rachis angular, to 9 cm long, singly branched; bracteoles not seen. **Flowers:** buds to 4 × 2 mm; *stamens 46–62*, *filaments and anthers glabrous*, *connectival appendage shorter than anther*, *glabrous but for 1–2 apical setae*; *ovary and stylopodium pyriform*. **Fruits:** *calyx lobes glabrescent*, *unequal*, *3 longer lobes to 6.5 × 1 cm*, *tapering to 3 mm above the saccate base*, *2 shorter ones to 3 × 0.3 cm*, *similar at base*. **Nuts** *ovoid-ellipsoid*, *to 1.2 × 0.7 cm*, *with to 3 mm tapering filiform style remnant*.

Vernacular name. Sarawak—*selangan batu tinteng* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Kota Belud, Kuala Penyu, Ranau and Sipitang districts (e.g., *SAN 16360*, *SAN 22088*, *SAN 22406*, *SAN 50947*, and *SAN 72276*) and in Sarawak from Julau, Kapit, Kuching, Lubok Antu, Lundu, Miri, Samarahan, Sri Aman, and Tatau districts (e.g., *S 15220*, *S 29623*, *S 36924*, *S 37708*, and *S 41374*). Also occurring in Brunei (e.g., *S 1183*) and W and SE Kalimantan (e.g., *Suzuki K 3565*).

Ecology. Locally frequent in mixed dipterocarp forest on leached yellow sandy clay soils and in upper dipterocarp forest, at altitudes to 1400 m. Occurring in Kinabalu and Mulu NPs; probably not yet vulnerable.

19. **Shorea bullata** P.S.Ashton

(Latin, *bullatus* = blistered; the leaf blade)

(sect. **Brachypterae**, red meranti)

Gard. Bull. Sing. 19 (1962) 283, *op. cit.* (1964) 181, *op. cit.* (1968) 105; *op. cit.* (1982) 517; Anderson *op. cit.* (1980) 125; Coode *et al.* (eds.) *op. cit.* 75; Newman *et al. op. cit.* (1996) 126. **Type:** *Ladi & Angga BRUN 2003*, Borneo, Brunei, Bangar (holotype K; isotypes KEP, L).

Low emergent tree, to 45 m tall, to 1.2 m diameter; bole straight; crown hemispherical with golden tinge from below; buttresses stout, to 1 m tall. **Bark** smooth, hoop-marked at first, mauve-grey and chocolate-brown mottled, becoming vertically cracked and patchily oblong flaky; inner bark and heartwood crimson. *Twig*, *outside of stipules*, *inflorescence*, *petiole and venation below persistently scabrid fulvous-pubescent*; *leaf bud*, *parts of perianth exposed in bud and leaf midrib above densely evenly so*; *blade above sparsely caducous hispid*; *ovary and nuts densely cream-brown pubescent*. **Twigs** *c*. 2 mm diameter apically, terete, much-branched, becoming papery flaky. Leaf buds broadly ovoid, 3–4 × 2–3 mm. **Stipules** *narrowly hastate*, *acute*, *to 7 × 2 mm*. **Leaves** *chartaceous*, *becoming concave and prominently bullate between the intercostal veins*, *drying dark reddish brown*; *blade elliptic to oblong-ovate*, *6.5–10 × 3–4.5 cm*, *base narrowly obtuse or broadly acuminate*, *margin usually revolute*, *apex obtuse or shortly broadly acuminate*; *midrib narrowly furrowed above*, *prominent below as also lateral veins*; *lateral veins 10–12 pairs*; *intercostal venation distantly scalariform*; *petiole 0.8–1 cm long*. **Inflorescences** terminal or axillary; rachis terete, lax, to 11 cm long, singly branched, branchlets bearing to 8 flowers; bracteoles broadly elliptic, obtuse, to 6 × 3.5 mm. **Flowers:** buds to 15 × 3 mm; petals cream with pink at base; stamens 15, *connectival appendage c. 4x the length of anther*, *slender*, *twisted towards apex*; ovary and stylopodium ovoid, densely short-pubescent, *style almost 2x the length of ovary*, *columnar*, *pubescent in basal half*. **Fruits:** *calyx lobes unequal*, *3 longer lobes to 9 × 1.3 cm*, *tapering to 5 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 3 × 0.3 cm*, *with a similar base*. **Nuts** ovoid, to 1 × 0.7 cm, acute.

Vernacular name. Sarawak—*meranti melecur* (preferred name).

Distribution. Endemic in Borneo. Known in Sarawak from Bintulu, Kapit, Kuching (sterile collection), Miri, and Tatau districts (e.g., *S 18378*, *S 27138* and *S 63844*). Also recorded from Brunei (e.g., *BRUN 924*, *BRUN 5773* and *BRUN 5798*).

Ecology. Rare, in scattered populations in mixed dipterocarp forest on yellow sandy clay soils, on low hills, at altitudes to 400 m. Occurring in Lambir and Mulu NPs; elsewhere endangered.

20. **Shorea calcicola** P.S.Ashton

(Latin, *calx* = limestone, *colere* = to grow; the natural habitat)

(sect. **Shorea**, subsect. **Shorea**)

TFSS 5 (2004) 479. **Type:** *Murthy & Chai S 24690*, Borneo, Sarawak, Kuching district, Kuching-Serian Road (holotype KEP; isotype SAR).

Medium-sized tree, occasionally to 50 m tall, to 1.2 m diameter, with low thin buttresses. **Bark** chocolate-brown, becoming flaky. *Inflorescence*, *flower calyx*, *twig and petiole at first buff puberulent*, *glabrescent*; *midrib above*, *parts of petal exposed in but*, *ovary and nut densely persistently buff pubescent*. **Twig** *c.* 2 mm diameter apically, terete, smooth, dark brown. **Stipules** unknown. **Leaves** *thickly coriaceous*, *somewhat lustrous and drying orange brown below*, *dark red-brown above*; *blade broadly ovate 10–14 × 5–7 cm*; *lateral veins c. 9 pairs*, *slender but raised below*, *evident but hardly raised above as also the midrib*; *intercostal venation densely scalariform*, *evident but hardly raised*; *petiole 2–3 cm long*, *distinctly geniculate*. Complete **inflorescences** unknown. **Flowers:** buds to 7 × 3 mm, fusiform; stamens 25–28, filaments and anther locules glabrous, connectival appendages surmounted by a single apical seta; ovary and stylopodium broadly pyriform. **Fruits:** pedicels *c.* 2 mm long, slender; 3 longer calyx lobes to 6 × 1.5 cm, broadly spathulate, obtuse, tapering to *c.* 4 mm broad above the saccate base, 2 shorter lobes to 2 cm long, linear, similar at base. **Nuts** ovoid, to 1.8 × 1.3 cm, tapering to a distinct apiculus.

Distribution. Endemic in Borneo. Not yet known in Sabah. In Sarawak recorded from Kuching and Serian districts (e.g., *S 12582*, *S 22777* and *S 28041*). One tentative collection from G. Subis, Miri district (*i.e.*, *S 27282*) and unconfirmed records (sterile) from the Mulu limestone hills.

Ecology. Locally quite common on organic soils over limestone, at altitudes below 400 m. Not vulnerable.

21. **Shorea carapae** P.S.Ashton

(from Iban word—*karapa* = swampy pole forest; the habitat)

(sect. **Brachypterae**, subsect. **Brachypterae**, red meranti)

Gard. Bull. Sing. 22 (1967) 294, *op. cit.* (1968) 105, *op. cit.* (1982) 551; Anderson *op. cit.* (1980) 125; Newman *et al. op. cit.* (1996) 127. **Type:** *Kostermans 13095*, Borneo, Kalimantan, W Kutei, Mt. Palimasan near Tabang, Ulu Belayan (holotype K; isotypes KEP, L).

Medium-sized canopy tree, to 35 m tall, to 65 cm diameter; bole frequently crooked; buttresses to 1 m tall but usually lower, stout. **Bark** becoming cracked and patchily flaky, chocolate and greyish brown mottled; inner bark orange-brown; heartwood yellow-brown. *Twig*, *leaf bud*, *stipule*, *petiole*, *and parts of corolla exposed in bud persistently densely evenly buff-sericeous*; *venation below and midrib above sparsely so*; *fruit calyx and pedicel sparsely puberulent*; *nuts glabrous.* **Twigs** compressed, *c. 3 × 2 mm apically*, *stipule scars prominent*, *almost amplexicaul.* Leaf buds lanceolate, compressed, acute, to 7 × 2 mm. **Stipules** *oblong-lanceolate*, *subacute*, *to 25 × 20 mm*, *caducous*. **Leaves** *thickly coriaceous*, *drying warm yellowish brown*; *blade broadly ovate to elliptic*, *14–18 × 7–10 cm*, *base obtuse to cordate*, *apex with short*, *broad acumen*; *midrib evident*, *flat to somewhat sunken above*, *prominent below*; *lateral veins 11–13 pairs*, *stoutly prominent below*; *intercostal venation slender*, *densely scalariform*, *unraised*; *petiole 2.3–3.5 cm long.* **Inflorescences** terminal or axillary; rachis terete, to 15 cm long, singly branched; bracteoles lanceolate, acute, to 16 × 5 mm, puberulent. **Flowers:** buds spindle-shaped, to 8 × 3 mm; stamens 15, irregularly whorled, filaments flat at base, shouldered medially, anthers ellipsoid, connectival appendage *c.* 3x the length of anther, acicular, erect; ovary small, ovoid, without stylopodium, finely sericeous, style 3x ovary, slender, stigma obscure. **Fruits:** pedicel short, stout; calyx lobes unequal, 3 longer lobes to 7 × 1.5 cm, tapering to *c.* 5 mm broad above the saccate base, 2 shorter ones linear-lobed, to 2.5 × 0.3 cm, similar at base. **Nuts** ovoid, to 1 × 0.7 cm, acute.

Distribution. Endemic in Borneo. Known in Sarawak from Belaga, Dalat, Kapit, Lubok Antu, and Marudi districts (e.g., *S 25895*, *S 40709*, *S 60087*, *S 62412*, and *S 69724*). Also occurring in E Kalimantan (e.g., the type); not yet recorded from Sabah.

Ecology. Locally frequent in swampy pole forest on organic soils on poorly drained plateaux over acid and also basic volcanic rocks and sandstone, at 800–1200 m altitude. Becoming vulnerable owing to logging.

22. **Shorea chaiana** P.S.Ashton

(P.P.K. Chai, former Senior Forest Botanist in the Sarawak Forest Department)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. Sing. 31 (1978) 42, *op. cit.* (1982) 477; Newman *et al. op. cit.* (1996) 128. **Type:** *Suib S 29722*, Borneo, Sarawak, Kapit district, Sg. Sepanggil (holotype K; isotype SAR).

Emergent tree, to 45 m tall, to 80 cm diameter; buttresses to 1 m tall. *Petiole*, *inflorescence*, *parts of perianth exposed in bud*, *ovary and nut persistently more or less densely cream-buff puberulent*; *fruit calyx lobes*, *twig and leaf venation below sparsely more or less caducously so*; other parts glabrous. **Twigs** *c.* 1 mm diameter apically, terete, much-branched. Leaf buds minute. **Stipules** not seen. **Leaves** *thinly coriaceous*, *drying greenish grey*; *blade elliptic-lanceolate*, *more or less distinctly falcate*, *6–11 × 2–4 cm*, *base cuneate or obtuse*, *margin narrowly subrevolute*, *apex with caudate acumen to 1.5 cm long*; *midrib prominent below*, *evident but flat to shallowly sunken above*; *lateral veins 8–11 pairs*, *slender but distinctly raised below*, *evident above*, *arched*; *intercostal venation reticulate*, *distinctly elevated below*; *petiole 0.5–0.8 cm long*, *slender.* **Inflorescences** terminal or axillary; rachis slender, to 6.5 cm long, singly branched. **Flowers:** buds to 5 × 2 mm; stamens 15, connectival appendage *c.* 2½x the length of anther; ovary ovoid-conical, stylopodium columnar, puberulent, style columnar, glabrous, as long as ovary. **Fruits** (young)**:** *calyx lobes subequal*, *short*, *ovate.*

Distribution. Endemic in Borneo. Known in C and NE Sarawak from the Rajang and Kemena hinterlands in Kapit district (e.g., *S 29626*, *S 29632* and *S 57838*). Also occurring in Brunei (e.g., *FMS 35478* and *FMS 35479*).

Ecology. Apparently not common, in mixed dipterocarp forest, at altitudes below 1000 m. Endangered owing to forest conversion.

23. **Shorea collaris** Slooten

(Latin, *collum* = neck; the rimmed fruit calyx)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Reinwardtia 3 (1956) 329; Ashton *op. cit.* (1968) 82, *op. cit.* (1982) 477; Anderson *op. cit.* (1980) 121; Newman *et al. op. cit.* (1996) 129. **Type:** *bb. 20650*, Borneo, Kalimantan, Long Pahangai, Mahakam (holotype BO; isotype L).

Emergent tree to 50 m tall, to 1.5 m diameter; bole tall, straight; buttresses to 2 m tall, stout almost straight. **Bark** pale yellowish brown, evenly vertically cracked and flaked leaving a scroll-marked surface below; coxcombs of black dammar frequent. *Petiole and leaf bud persistently greyish buff-sericeous*; *young twig caducously so*; *inflorescence*, *parts of perianth exposed in bud*, *ovary*, *stylopodium*, *and nut greyish buff-puberulent or glabrous.* **Twigs** *c.* 2 mm diameter apically, terete. Leaf buds ovoid, subacute, to 2 × 2 mm. **Stipules** unknown. **Leaves** *somewhat chartaceous*, *drying dull greyish green below*, *greyish brown above*; *blade oblong-lanceolate*, *13–23 × 4.3–8.5 cm*, *base obtuse*, *margin usually narrowly revolute*, *apex with broad acumen to 1 cm long*; *midrib slender but prominent below*, *evident and flat above*; *lateral veins c. 13 pairs*, *slender but elevated below*; *intercostal venation slender*, *hardly raised*, *scalariform*; *petiole 1.9–3 cm long*, *slender.* **Inflorescences** terminal or axillary; rachis terete, to 9 cm long, singly branched, branchlets bearing to 8 flowers; bracteoles fugaceous. **Flowers:** buds to 5 × 3 mm; *stamens 10*, *connectival appendage c. 2½x the length of anther*, *sparsely sericeous towards apex*; *ovary and stylopodium pyriform*, *style short.* **Fruits:** pedicels to 3 mm long; *calyx glabrescent*, *lobes equal*, *ovate*, *acute*, *clasping the nut at base*, *more or less reflexed distally giving a collared appearance*, *to 1 × 0.9 cm*. **Nuts** *broadly obovoid-ellipsoid*, *to 3 × 2 cm*, *apiculate.*

Vernacular names. Sarawak—*lun kunyit* (preferred name), *merakunyit* (Iban).

Distribution. Endemic in Borneo. Known in Sabah from G. Ampuria, Beaufort district (e.g., *SAN 43580*) and in Sarawak from Kapit, Samarahan, Simunjan, and Tatau districts (e.g., *S 19307*, *S 23246*, *S 29612*, *S 60142*, and *S 67579*). Also occurring in SE Kalimantan (e.g., *bb. 20479*, *bb. 20658* and the type).

Ecology. Frequent in mixed dipterocarp forest on clay rich soils at low altitudes, often near streams, including on the Iju rhyolite and Mersing basalt, at altitudes to 500 m. Endangered owing to forest conversion.

24. **Shorea confusa** P.S.Ashton

(Latin, *confusus* = confused; long confused with *S. virescens*)

(sect. **Anthoshorea**, white meranti)

Gard. Bull. Sing. 31 (1978) 44, *op. cit.* (1982) 497; Coode *et al.* (eds.) *op. cit.* 76; Newman *et al*. *op. cit.* (1996) 129. **Synonym:** *Shorea virescens auct. non* Parijs: Ashton *op. cit.* (1964) 167, *op. cit.* (1968) 95, Meijer & Wood *op. cit.* 60, Burgess *op. cit.* 159. **Type:** *Meijer SAN 19395*, Borneo, Sabah, Tawau, Mile 24, Cocoa Estate (holotype K; isotypes KEP, SAN).

Large emergent tree, to 50 m tall, to 1.7 m diameter, with large hemispherical crown; bole straight; buttresses to 3 m tall, stout. **Bark** pale fawn-brown, closely shallowly cracking and thinly flaking; inner bark laminated pale orange-brown and cream. *Leaf bud*, *parts of perianth exposed in bud*, *ovary*, *inflorescence*, *stipule outside*, *petiole*, *and very young twig caducous puberulent.* **Twigs** 2–3.5 mm diameter apically, frequently rugulose. Leaf buds conical, acute, 3–4 × 2 mm. **Stipules** *linear to deltoid*, *subacute*, *c. 8 × 3 mm*. **Leaves** *thinly coriaceous*, *drying yellowish brown with the venation paler than the blade below*; *blade elliptic to slightly obovate*, *6–12 × 3.5–5 cm*, *base obtuse*, *apex with broad acumen to 1 cm long*; *midrib prominent below*, *obscurely furrowed above*; *lateral veins* (*10–*)*13–18 pairs*, *arched*, *slender but raised below*; *intercostal venation evident*, *scalariform*; *petiole 1–1.5 cm long*, *c. 1 mm diameter*, *slender.* **Inflorescences** terminal or axillary; rachis terete, lax, to 22 cm long, singly or doubly branched, branches bearing to 6 flowers; bracteoles not observed. **Flowers:** buds to 9 × 5 mm; *stamens 15*, *anther oblong*, *connectival appendage c. 3x the length of anther*; ovary ovoid, without stylopodium small, puberulent, *style c. 3x the length of ovary*, *sericeous in basal two-thirds.* **Fruits:** *pedicels stout*, *base of fruit tapering*; *3 longer calyx lobes to 12 × 1.5 cm*, *hardly tapering above the saccate base*, *2 shorter ones unequal*, *linear-lobed*, *to 6 × 0.5 cm*, *with similar base*. **Nuts** ovoid, to 2 × 1.5 cm, with *c.* 6 mm slender style remnant.

Vernacular name. Sabah—*melapi sulang saling* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Kinabatangan, Kota Belud, Kota Kinabalu, Kota Marudi, Lahad Datu, Sandakan, Tawau, and Tenom districts (e.g., *SAN 15027*, *SAN 16349*, *SAN 16592*, *SAN 40334*, and *SAN 97247*) and in Sarawak from Kapit, Lawas, Marudi, and Miri districts (e.g., *S 1533*, *S 17771*, *S 23023*, and *S 41224*). Also occurring in Brunei (e.g., *BRUN 2004* and *BRUN 5281*) and E Kalimantan.

Ecology. Frequent in mixed dipterocarp forest on clay-rich soils, on undulating land and hills, at altitudes to 600 m. Recorded in Lambir NP; elsewhere vulnerable.

Notes. *Shorea virescens*, with which this species was formerly confused, differs in its velutinate young parts, compressed twigs and larger number of lateral veins. *Shorea confusa* differs from *S. agami* notably in its more slender and paler lateral veins below, and the tapered base of its fruit. One collection with young fruit (*SAN 33016* from Kelumpang, Tawau district) may represent *S. assamica* Dyer which occurs in E Kalimantan. Flowering material is required for confirmation.

25. **Shorea cordata** P.S.Ashton

(Latin, *cordatus* = heart-shaped; the leaf base)

(sect. **Anthoshorea**, white meranti)

Gard. Bull. Sing. 22 (1967) 285, *op. cit.* (1968) 93, *op. cit.* (1982) 495; Anderson *op. cit.* (1980) 123; Newman *et al. op. cit.* (1996) 130. **Type:** *Smythies SA 678*, Borneo, Sarawak, Kuching district, near Semengoh FR (holotype K).

Large emergent tree, to 50 m tall, to 1 m diameter, with tall straight bole; buttresses to 3 m tall, stout. **Bark** pale chocolate-brown, irregularly cracked; inner bark pale brown, obscurely laminated. *Young twig and petiole densely caducous greyish brown puberulent*; *stipule and leaf venation sparsely so*; *leaf bud and parts of perianth exposed in bud persistently so*. **Twigs** at first somewhat compressed *c.* 3 × 2 mm apically; stipule scars horizontal, pale, prominent. Leaf buds ellipsoid, compressed, acute, to 7 × 4 mm. **Stipules** elliptic, obtuse, to 12 × 6 mm. **Leaves** *coriaceous*, *drying chocolate-brown below*; *blade oblong to obovate*, *8–15 × 5.5–10.5 cm*, base cordate to obtuse, apex obtuse, retuse or abruptly shortly acuminate; *midrib prominent below*, *furrowed above*; *lateral veins 15–18 pairs*, *prominent below*; *intercostal venation slender*, *densely scalariform*; *petiole 1.2–2.5 cm long*, *frequently becoming rugulose.* **Inflorescences** terminal or axillary; rachis lax, compressed or ribbed, to 12 cm long, singly branched, branchlets bearing to 5 flowers; bracteoles elliptic, obtuse, to 10 × 5 mm, not at first caducous. **Flowers:** buds to 10 × 5 mm; petals pale yellow tinged pink at base within; *stamens 15*, *connectival appendage 3–4x the length of anther*, *scabrous*; *ovary puberulent distally*, *style c. 2x as long as ovary.* **Fruits:** *calyx* glabrous; 3 longer lobes to 13 × 2.5 cm, tapering to 8 mm above the saccate base, 2 shorter ones unequal, to 6.5 × 0.8 cm, similar at base. **Nuts** narrowly ovoid, to 1.4 × 1 cm, with to 4 mm slender style remnant.

Distribution. Endemic in Borneo. Known in Sarawak from Kuching, Lundu and Tatau districts (e.g., *S 10177*, *S 13183*, *S 19306*, and *S 68788*). Also occurring in NW Kalimantan.

Ecology. Rare and probably endangered, in mixed dipterocarp forest, apparently on clay-rich soils especially on igneous rocks, at altitudes below 500 m.

26. **Shorea coriacea** Burck Plate 3F.

(Latin, *coriaceus* = leathery; the leaf blade)

(sect. **Brachypterae**, red meranti)

Ann. Jard. Bot. Buitenz. 6 (1887) 214; Merrill *op. cit.* (1921) 404; Masamune *op. cit.* 493; Browne *op. cit.* 146; Ashton *op. cit.* (1964) 182, *op. cit.* (1968) 106, *op. cit.* (1982) 509; Meijer & Wood *op. cit.* 102; Burgess *op. cit.* 154; Anderson *op. cit.* (1980) 125; PROSEA *op. cit.* 393; Kessler & Sidiyasa, TBSA-EK (1994) 102; Coode *et al.* (eds.) *op. cit.* 76; Newman *et al. op. cit.* (1996) 131. **Type:** *Beccari PB 2948*, Borneo, Sarawak (holotype BO; isotypes A, K).

Large emergent tree, to 50 m tall, to 1.4 m diameter, with straight bole; buttresses to 1.5 m tall, stout. **Bark** dark chocolate-brown, narrowly fissured and flaky; inner bark pinkish brown; heartwood deep crimson. *Young parts densely pale grey sericeous*, *caducous except on stipule outside*, *leaf bud*, *parts of perianth exposed in bud and inflorescence*; *ovary and nut puberulent except at base.* **Twigs** terete or slightly compressed, 2–3 mm diameter apically; *stipule scars cuneate*, *pale brown*, *horizontal or slightly descending.* Leaf buds ovoid, to 6 × 3 mm. **Stipules** narrowly oblong, acute, to 20 × 5 mm. **Leaves** *coriaceous*, *lustrous*, *drying dark reddish brown below*; *blade ovate*, *10–15 × 5–8 cm*, *base obtuse*, *obscurely subpeltate*, *margin narrowly revolute*, *apex with acumen to 1 cm long*; *midrib prominent below*, *obscurely sunken above*; *lateral veins 16–20 pairs*, *slender*, *hardly raised below*, *curved within margin*; *intercostal venation densely scalariform*, *unraised*; *petiole geniculate*, *drying black*, *2.5–4 cm long.* **Inflorescences** terminal or axillary; rachis terete, to 14 cm long, singly or doubly (if terminal) branched, branchlets bearing to 10 flowers; bracteoles ovate, subacute, to 4 × 2.5 mm. **Flowers:** buds to 6 × 1.2 mm; petals pink; *stamens 15*, *connectival appendage 2–3x the length of anther*; ovary ovoid, densely short-pubescent except at the base, stylopodium indistinct, *style as long as ovary.* **Fruits:** *calyx lobes unequal*, *2 longer lobes to 9 × 1.5 cm*, *tapering to 4–5 mm at the saccate base*, *2 shorter ones subequal*, *linear-lobed*, *to 3.5 cm long*, *similar at base.* **Nuts** ovoid, to 1.8 × 0.9 cm, with *c.* 3 mm slender style remnant.

Vernacular names. Sabah—*seraya tangkai panjang* (preferred name). Sarawak—*meranti tangkai panjang* (preferred name).

Distribution. Endemic in Borneo. Known in Sabah from Sipitang district (e.g., *SAN 16682* and *SAN 69878*) and in Sarawak from Bau, Belaga, Kuching, Lawas, Lundu, and Tatau districts (e.g., *S 363*, *S 9484*, *S 11095*, *S 32776*, and *S 64942*). Also occurring in Brunei (e.g., *BRUN 3335*) and W, C and E Kalimantan (e.g., *Ambriansyah and Arifin AA 41*, *bb. 29692* and *Laman et al. TL 1348*).

Ecology. Locally abundant in *kerangas* forest especially on deep podsols, in the lowlands and on sandstone and acid volcanic plateaux in the lower montane zone, at 100–1200 m altitude; on ultrabasic substrate in eastern Sabah; occasional in mixed dipterocarp forest in the *kerangas* ecotone. Occurring in Mulu NP; elsewhere becoming endangered.

27. **Shorea crassa** P.S.Ashton

(Latin, *crassus* = thick; the leaf blade)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

Gard. Bull. Sing. 20 (1963) 271, *op. cit.* (1964) 130, *op. cit.* (1968) 69, *op. cit.* (1982) 457; Anderson *op. cit.* (1980) 119; Coode *et al.* (eds.) *op. cit.* 76; Newman *et al. op. cit.* (1998) 172. **Type:** *Ismail S 11701*, Borneo, Sarawak, Semengoh FR (holotype K; isotype KEP).

Emergent tree, to 45 m tall, to 1.1 m diameter, with straight bole; buttresses to 1.5 m tall, thin, sharp. **Bark** tawny to purplish brown, vertically cracked and irregular flaky. *Twig*, *inflorescence*, *leaf bud*, *parts of perianth exposed in bud*, *ovary*, *nut*, *stipule outside*, *and petiole densely greyish-puberulent*; *venation below and fruit calyx sparsely so.* **Twigs** at first somewhat compressed, *c*. 5 × 2.5 mm apically; stipule scars *c*. 2 mm long, pale, ascending. Leaf buds ovoid, compressed, subacute, to 6 × 6 mm. **Stipules** ovate, acute, concave, to 8 × 4 mm, fugaceous. **Leaves** *thickly coriaceous*, *pale cream to golden lepidote below*; *blade elliptic to ovate*, *10–18 × 5–10 cm*, *base equal or subequal*, *cuneate or narrowly obtuse*, *occasionally subcordate*, *apex with tapering acumen to 1 cm long*; *midrib prominent below*, *applanate above to sunken towards apex*, *evident*; *lateral veins 7–11 pairs*, *prominent below*, *well-spaced*, *ascending*; *intercostal venation densely scalariform*, *sinuate*, *unraised*; *petiole 3.5–5 cm long*, *stout*, *somewhat geniculate.* **Inflorescences** terminal or axillary; rachis terete or somewhat compressed, ribbed on drying, stout, to 13 cm long, singly branched, branchlets bearing to 12 flowers; bracteoles suborbicular, to 3 mm across, caducous. **Flowers:** buds to 15 × 3.5 mm; petals cream, pink at base; *stamens 38–46*, *filaments hispid*, *connectival appendage prominent but shorter than the anther*, *setose*; *ovary ovoid*, *stylopodium cylindrical longer than ovary*, *style glabrous*, *short.* **Fruits:** *calyx lobes unequal*, *3 longer lobes to 9 × 2.5 cm*, *tapering to 8 mm above the saccate base*, *2 shorter ones narrowly oblong*, *to 7 × 0.7 cm*, *similar at base*. **Nuts** ellipsoid, to 2.5 × 2 cm, tapering into stout to 8 mm long style remnant.

Vernacular name. Sarawak—*selangan batu daun tebal* (preferred name).

Distribution. Endemic in Borneo. Known in Sarawak from Bintulu, Kapit, Kuching, Lundu, and Miri districts (e.g., *S 6210*, *S 9468*, *S 32051*, *S 46484*, and *S 59866*). Also occurring in Brunei (e.g., *BRUN 570* and *BRUN 642*) and C and W Kalimantan (e.g., *bb. 17036* and *bb. 26409*).

Ecology. Locally common in mixed dipterocarp forest on deep yellow sandy soils in the lowlands, and occasionally at altitudes to 1000 m on sandstone. Occurring in Mulu NP; elsewhere vulnerable.

28. **Shorea curtisii** Dyer *ex* Brandis

(C. Curtis, 1853–1928, first Curator of Waterfall gardens, Penang, Peninsular Malaysia)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

J. Linn. Soc. Bot. 31 (1895) 101; Symington *op. cit.* (1943) 67; Browne *op. cit.* 147; Ashton *op. cit.* (1964) 185, *op. cit.* (1968) 106, *op. cit.* (1982) 541; Meijer & Wood *op. cit.* 103; Burgess *op. cit.* 166; Anderson *op. cit.* (1980) 125; PROSEA *op. cit.* 393; Coode *et al.* (eds.) *op. cit.* 76; Newman *op. cit.* (1996) 541. **Lectotype** (designated here)**:** *Curtis 1394*, Peninsular Malaysia, Penang Hill (hololectotype K).

Notes. Two subspecies, subsp. *curtisii* and subsp. *grandis* P.S.Ashton, are recognised. Of the two, only subsp. *curtisii* occurs in Sabah and Sarawak.

subsp. **curtisii**

Vast emergent tree, to 70 m tall, to 2 m diameter, *with huge hemispherical cauliflower-shaped crown*, *sea-green from a distance*; buttresses to 1.8 m tall, stout. **Bark** becoming pinkish brown, deeply v-section fissured and eventually crumbly flaky; inner bark thick, pinkish brown; heartwood pale crimson. *Young twig*, *inflorescence*, *leaf bud*, *parts of perianth exposed in bud*, *stipule outside*, *ovary*, *nut*, *petiole*, *and midrib and veins below* *densely evenly more or less persistently pinkish brown to grey puberulent.* **Twigs** *c*. 1.5 mm diameter apically, slender, terete, much branched. *Leaf buds ovate to slightly falcate*, *subacute*, *4–9 × 2.5–3.5 mm*. **Stipules** *oblong*, *obtuse*, *to 10 × 4 mm*. **Leaves** *coriaceous*, *pale pink to grey lepidote and dull below*; *blade ovate-lanceolate*, *6–9 × 2.5–3.5 cm*, *base broadly cuneate*, *apex with narrow acumen to 0.8 cm long*; *midrib slender*, *terete*, *prominent below*, *obscure*, *slightly sunken above*; *lateral veins 9–11 pairs*, *slender*, *hardly raised below*, *arched*; *intercostal venation obscure*, *slender*, *densely scalariform*; *petiole 1–1.3 cm long*, *slender*. **Inflorescences** terminal or axillary; rachis terete, to 6 cm long, singly or doubly branched, branchlets bearing to 12 flowers; bracteoles elliptic, subacute, to 2.5 × 2 mm, fugaceous. **Flowers:** buds to 5 × 3 mm; *petals deep crimson*; *stamens 15*, *connectival appendage short or rudimentary*; *ovary and stylopodium ovoid*, *style short*. **Fruits:** pedicels *c*. 1 mm long; *calyx lobes unequal*, *3 longer lobes to 7 × 1 cm*, *tapering to c. 2.5 mm above the saccate base*, *2 shorter ones unequal*, *linear-lobed*, *to 4 × 0.3 cm*, *similar at base*. **Nuts** ovoid, to 1.2 × 0.9 cm, tapering to 1 mm apiculus.

Vernacular name. Sabah and Sarawak—*seraya* (preferred name).

Distribution. SE Peninsular Thailand, Sumatra (Singkep and Lingga), Peninsular Malaysia, and Borneo. In Borneo, known in Sabah from Sipitang district (e.g., *SAN 15185*) and in Sarawak from Bintulu, Miri and Mukah districts (e.g., *S 15146*, *S 23606*, *S 23653*, and *S 46414*). Also occurring in Brunei (e.g., *BRUN 246*, *BRUN 2538* and *BRUN 3279*).

Ecology. Locally common in mixed dipterocarp forest on deep yellow sands along the Neogene coastal hills. Recorded in Brunei and Ulu Limbang from shallow organic soils along shale ridges to *c*. 1200 m altitude in upper dipterocarp forest. Locally frequent in Lambir and Mulu NPs. Vulnerable in Sarawak outside the parks; critically endangered in Sabah.

29. **Shorea cuspidata** P.S.Ashton

(Latin, *cuspis* = a cusp; the slightly swollen acumen apex)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. Sing. 22 (1967) 290, *op. cit.* (1968) 82, *op. cit.* (1982) 483; Anderson *op. cit.* (1980) 121; Newman *et al. op. cit.* (1996) 134. **Type:** *Galau S 15258*, Borneo, Sarawak, Kuching, Semengoh FR (holotype K; isotype KEP).

Low emergent tree, to 45 m tall, to 1 m diameter, with straight bole; buttresses to 3 m tall, rather thin. **Bark** surface at first v-section zig-zag fissured, later flaking in small oblong pieces leaving a scroll-marked surface. *Leaf bud*, *parts of perianth exposed in bud*, *ovary*, *nut*, *stipule*, *bracteole*, *and inflorescence shortly densely buff-puberulent*; *young twig and fruit calyx caducously so*; *parts otherwise glabrous.* **Twigs** *c*. 1 mm diameter apically, slender, becoming minutely striated. Leaf buds ovoid, *c*. 1 mm long, small. **Stipules** not seen. **Leaves** *thinly coriaceous*, *drying greenish to yellowish brown*; *blade broadly ovate*, *5–9 × 2–6 cm*, *base broadly cuneate*, *apex caudate-cuspidate*, *acumen to 1.5 cm long*; *midrib slender*, *evident and flat or elevated above*, *prominent below*; *lateral veins 5–7 pairs*, *slender*, *hardly raised below*, *arched*; *intercostal venation obscure*, *reticulate*; *petiole 0.7–1.1 cm long*, *slender*. **Inflorescences** terminal or axillary; rachis slender, terete, to 9 cm long, singly branched. **Flowers:** buds to 3 × 2 mm; petals pale lime-yellow; *stamens 15*, *connectival appendage c. 1½x the length of anther*, *sericeous distally*; *ovary and* *stylopodium pyriform*, *style glabrous*, *short.* **Fruits:** pedicels *c.* 1 mm long; *calyx lobes unequal*, *3 longer lobes to 5 × 1.5 cm*, *tapering to 5 mm above the narrowly saccate tuberculate base*, *2 shorter ones to 4 × 1 cm*, *otherwise similar*. **Nuts** *obovoid*, *mucronate*, *to 2.5 × 1.5 cm.*

Vernacular name. Sarawak—*lun runching padi* (preferred name).

Distribution. Endemic in Borneo; known in Sarawak from Bau, Kuching, Lundu, Miri, and Simunjan districts (e.g., *S 6513*, *S 9607*, *S 9843*, *S 15211*, and *S 49991*). Also occurring in W Kalimantan (e.g., *Suzuki K 9542*).

Ecology. Frequent to locally abundant in mixed dipterocarp forest on yellow sandy soils over the Plateau Sandstone, also on leached clay-rich soils on other substrates, on undulating ground and low hills, at altitudes to 500 m. Common in Bako NP and recorded from Lambir NP; elsewhere endangered by land conversion.

30. **Shorea dasyphylla** Foxw.

(Greek, *dasy*- = markedly hairy, *phullon* = leaf; the pubescent leaf)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

Malay. For. Rec. 10 (1932) 224; Browne *op. cit.* 138; Ashton *op. cit.* (1968) 106, *op. cit.* (1982) 546; Anderson *op. cit.* (1980) 125; PROSEA *op. cit.* 394; Newman *et al. op. cit.* (1996) 135. **Type:** *Symington KEP 24462*, Peninsular Malaysia, Selangor, Sg. Buloh FR (holotype KEP).

Medium-sized emergent tree, to 45 m tall, to 1.1 m diameter, with dense hemispherical crown; bole straight; buttresses to 1.5 m tall, stout. **Bark** dark greyish brown, deeply v-section fissured; inner bark and heartwood rich crimson. *Twig*, *leaf bud*, *inflorescence*, *parts of perianth exposed in bud*, *ovary*, *nut*, *stipule*, *bracteole*, *petiole*, *leaf below*, *and midrib above densely persistently golden brown scabrid-pubescent*; *blade above puberulent.* **Twigs** *c.* 2 mm diameter apically, terete. Leaf buds ovoid, obtuse, to 3 × 2 mm. **Stipules** broadly ovate, obtuse, to 6 × 4 mm, caducous. **Leaves** *coriaceous*, *drying pale yellowish brown below*, *pale mauve-brown above*; *blade ovate to elliptic*, *7–14 × 3–6 cm*, *obtuse or broadly cuneate*, *margin somewhat revolute*, *base obtuse or broadly cuneate, apex with slender acumen to 0.6 cm long*; *midrib prominent below*, *terete*, *striated*, *furrowed above*; *lateral veins 11–15 pairs*, *prominent below*; *intercostal venation scalariform*, *elevated below*; *petiole 1.2–1.5 cm long.* **Inflorescences** terminal or axillary; rachis terete or ribbed, to 8 cm long, singly branched, branchlets bearing to 4 flowers; bracteoles elliptic, obtuse, to 3 × 2 mm, caducous. **Flowers:** buds to 4 × 3 mm; petals cream-yellow; stamens 15, connectival appendage short, slender, becoming reflexed; ovary and stylopodium ovoid to conical, style shorter than ovary, glabrous. **Fruits:** pedicel to 2 mm long; *calyx lobes unequal*, *3 longer lobes to 9 × 1.3 cm*, *tapering to c. 4 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 4 × 0.4 cm*, *similar at base*. **Nuts** ovoid, shortly apiculate, to 1.8 × 0.9 cm.

Vernacular name. Sarawak—*meranti batu* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo known in Sabah from Tambunan district (e.g., *KEP 80416*) and in Sarawak from Bau, Kuching, Limbang, and Lundu districts (e.g., *S 6515*, *S 10305*, *S 15432*, *S 25230*, and *S 37803*). Also occurring in SE Kalimantan (e.g., *bb. 34435*).

Ecology. Frequent, sometimes common, in mixed dipterocarp forest on yellow sandy clay soils, at altitudes below 400 m. Common in Bako NP; elsewhere vulnerable owing to land conversion.

31. **Shorea dealbata** Foxw.

(Latin, *dealbatus* = whitewashed; the leaf undersurface)

(sect. **Anthoshorea**, white meranti)

Malay. For. Rec. 10 (1932) 192; Symington *op. cit.* (1943) 35; Ashton *op. cit.* (1968) 93, *op. cit.* (1982) 485; Anderson *op. cit.* (1980) 123; PROSEA *op. cit.* 410; Newman *et al. op. cit.* (1996) 136. **Type:** *Mat Sohor KEP 4188*, Peninsular Malaysia, Pahang, Kuantan district, Jambu, Lepar (holotype KEP).

Low emergent or main canopy tree, to 30 m tall, to 60 m diameter, with straight bole and low stout buttresses. **Bark** at first mottled brown and grey, hoop-marked, becoming deeply irregularly cracked, rotting off in flakes in between; inner bark finely pale rust and cream laminated. *Young twigs*, *leaf buds*, *parts of perianth exposed in bud*, *stipule and bracteole outside*, *petiole*, *and nut densely dark-fulvous pubescent*; *inflorescence similarly hirsute*, *venation below fugaceously so*; *blade below pale pink-brown lepidote*. **Twigs** *compressed*, *c. 4 × 2 mm apically*. Leaf buds ovoid, conical, subacute, to 6 × 4 mm. **Stipules** elliptic-oblong, subacute, to 20 × 5 mm. **Leaves** *thickly coriaceous*, *turned up along the midrib*, *drying dull olive-brown above*, *pale pinkish grey below with petiole*; *blade ovate to elliptic*, *8–16 × 4–7.5 cm*, *base obtuse or occasionally cuneate*, *apex with narrow acumen to 1 cm long*; *midrib prominent*, *subacute*, *below*, *obscurely sunken above*; *lateral veins* (*11–*)*20–24 pairs*, *obscure and slightly depressed above*, *slender and hardly elevated below*, *ascending*; *petiole stout*, *becoming rugose*, *1.5–2.5 cm long*. **Inflorescences** axillary or terminal, rachis terete or angular, unbranched or singly branched; bracteole unknown. **Flowers:** buds to 12 × 5 mm; petals white tinged with pink at base; *stamens 17*, *anthers narrowly oblong*, *connectival appendage stout at base*, *tapering and slender apically*, *c. 3x the length of anther*; *ovary ovoid*, *sparsely sericeous*, *without stylopodium*, *style filiform*, *trifurcate apically*, *sericeous in the basal half.* **Fruits:** *pedicels to 5 mm long*, *slender*; *calyx lobes unequal*, *3 longer lobes to 9 × 1.3 cm*, *tapering to 4 mm above the saccate base*, *2 shorter ones lorate-lobed*, *to 6.5 × 0.5 cm*, *similar but narrower at base.* **Nuts** *narrowly ovoid*, *to 1.8 × 0.8 cm*, *with to 3 mm slender style remnant.*

Vernacular name. Sarawak—*meranti bumbung* (preferred name).

Distribution. Sumatra (Lingga), Peninsular Malaysia and Borneo. In Borneo known only in Sarawak from Kuching district (e.g., *S 9409*, *S 10139*, *S 12476*, and *S 32730*).

Ecology. Very local, but there often common, in *kerangas* forest on white sand terraces and on sandstone plateau, at altitudes to 600 m. Occurring in Bako NP; elsewhere vulnerable.

32. **Shorea dispar** P.S.Ashton

(Latin, *dispar* = unlike; the flowers, compared with those of *S. parvifolia* with similar leaves)

(sect. **Rubella**, red meranti)

Gard. Bull. Sing. 31 (1978) 45, *op. cit.* (1982) 502; Newman *et al. op. cit.* (1996) 157. **Type:** *Othman S 29208*, Borneo, Sarawak, Kapit, Ulu Baleh above Nanga Mengiong (holotype K; isotypes KEP, L).

Large buttressed emergent tree. *Twig*, *petiole*, *bud*, *inflorescence*, *and parts of perianth exposed in bud densely persistently pale-tawny puberulent*; *leaf venation below sparsely so*; *parts otherwise glabrous*. **Twigs** *c*. 2 mm diameter apically, terete, much branched. Leaf buds ellipsoid, obtuse, to 3 × 2 mm. **Stipules** unknown. **Leaves** *coriaceous*, *somewhat cream lepidote below*; *blade elliptic*, *4–7 × 2–3.5 cm*; *midrib prominent below*, *obscurely sunken above as also the veins*; *lateral veins 9–11 pairs*, *ascending*; *intercostal venation scalariform*, *obscure*, *unraised*; *petiole 1.2–1.6 cm long.* **Inflorescences** terminal or axillary; rachis rigid, ascending, singly branched, to 8 cm long. **Flowers:** *buds ovoid*, *plump*, *to 6 × 4 mm*; *sepals subequal*, *broadly ovate*, *acute*; *petals lanceolate*, *contorted*; *stamens c. 25*, *filaments lorate*, *somewhat tapering*, *anthers oblong*, *connectival appendage c. ¾x the length of anther*, *stout, becoming somewhat reflexed*; *ovary ovoid*, *without stylopodium*, *small*, *glabrous*, *style filiform*, *c. 2x the length of ovary.* **Fruits:** pedicels to 1 mm; *calyx lobes unequal*, *3 longer lobes to 9 × 2 cm*, *more or less tapering to a more or less subauriculate base*, *2 shorter ones lorate-lobed*, *to 2.5 × 0.5 cm*, *not auriculate*. **Nuts** *ovoid*, *to 3 × 1.5 cm*, *apiculate*, *glabrous*.

Distribution. Endemic in Sarawak; known only from the Ulu Baleh, Kapit district (e.g., *S 29489* and *S 29639*).

Ecology. In mixed dipterocarp forest on shale ridges, at 500–600 m altitudes. Rare and critically endangered.

33. **Shorea domatiosa** P.S.Ashton

(Latin, *domus* = a dwelling; the leaf domatia, dwellings for acarines)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

Gard. Bull. Sing. 19 (1962) 285, *op. cit.* (1964) 131, *op. cit.* (1968) 69, *op. cit.* (1982) 460; Meijer & Wood *op. cit.* 166; Burgess *op. cit.* 202; Anderson *op. cit.* (1980) 119; Coode *et al.* (eds.) *op. cit.* 76; Newman *et al. op. cit.* (1998) 173. **Type:** *G.H.S. Wood SAN 16601*, Borneo, Sabah, Sipitang (holotype KEP).

Large emergent tree, to 50 m tall, to 1.2 m diameter, with diffuse pale hemispherical crown; bole straight; buttresses to 2 m tall, thin, prominent. **Bark** becoming vertically cracked and thinly oblong flaky, pale fawn-brown. *Inflorescence*, *parts of perianth exposed in bud*, *ovary except at base and apex*, *nut*, *and stipules cream puberulent*; *domatia fimbriate*; *parts otherwise glabrous.* **Twigs** *c*. 1.5 mm diameter apically, slender, much-branched. Leaf buds ovoid, acute, *c*. 4 × 2 mm. **Stipules** ovate, narrowly acute, to 6 × 2.5 mm, caducous. **Leaves** *chartaceous*, *cream lepidote below* (*mature tree*), *drying dark greyish brown*; *blade broadly ovate to obovate*, *6.5–10 × 3–7 cm*, *base obtuse to subcordate*, *subequal*, *apex with acumen to 0.8 cm long*; *midrib raised but not prominent below*, *more or less flat*, *evident*, *above*;

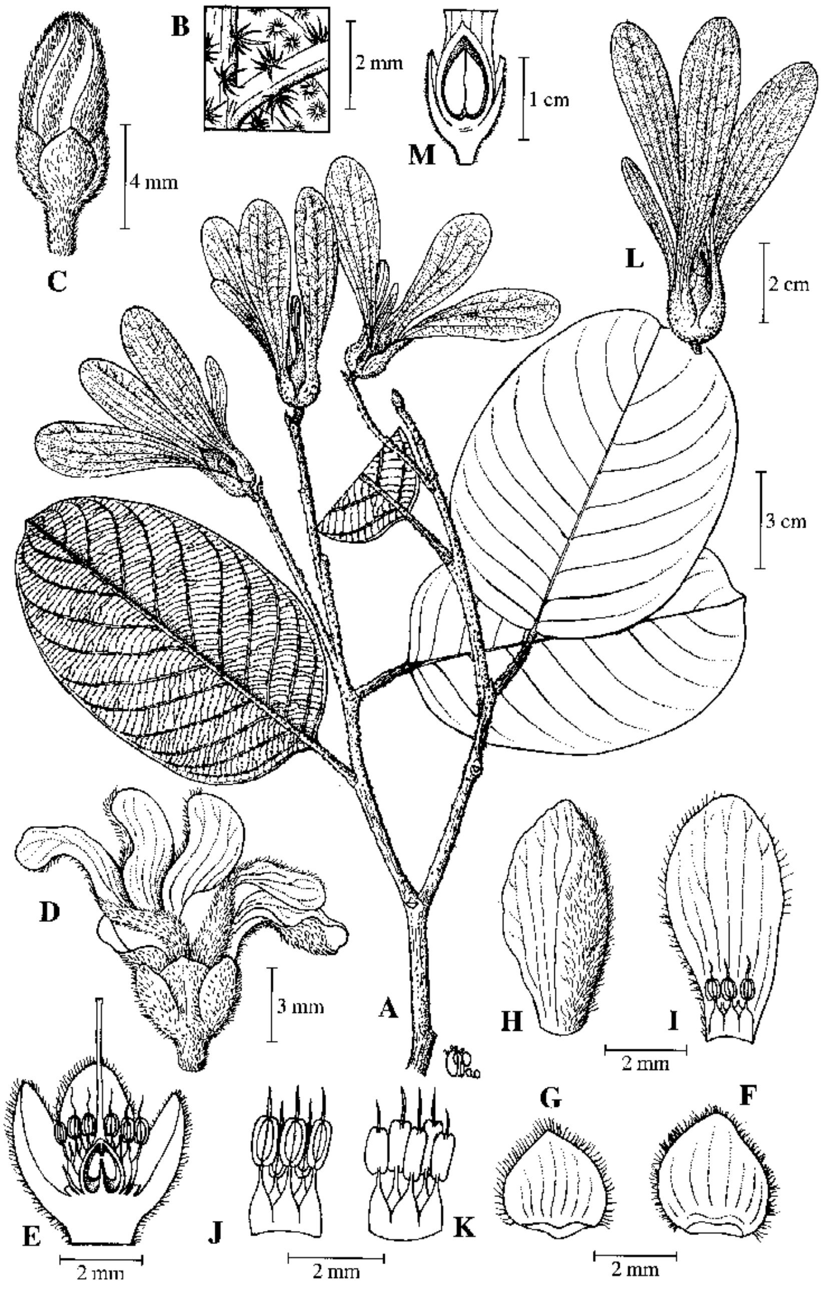

Fig. 23. *Shorea elliptica.* A, fruiting leafy twig; B, detail of indumentum on lower leaf surface; C, flower bud; D, open flower; E, longitudinal section of open flower with petals removed; F, adaxial view of outer sepal; G, adaxial view of inner sepal; H, abaxial view of petal; I, adaxial view of petal with stamens; J, adaxial view of stamens; K, abaxial view of stamens; L, fruit; M, longitudinal section of fruit. (A–B and L from *S 15794*, C–K from *S 37698*, M from *S 29468*.)

lateral veins 8–12 pairs, *slender*, *arched*, *elevated below*, *with small pore-like domatia*; *intercostal venation slender*, *densely scalariform*, *sinuate*; *petiole 1.5–2.5 cm long*, *slender*, *geniculate and swollen in the distal half.* **Inflorescences** terminal or axillary; rachis terete, to 7 cm long, singly branched, branches bearing to 5 flowers. **Flowers:** buds to 13 × 4 mm; *stamens 25–30*, *anthers sparsely setose towards apices*, *connectival appendage c. ¼x the length of anther*, *stout*, *setose*; *ovary small*, *ovoid*, *stylopodium 1½x the length of ovary*, *slender*, *style glabrous*, *short.* **Fruits:** *calyx glabrous*, *lobes unequal*, *3 longer lobes to 13 × 3 cm*, *tapering to 8 mm above the saccate base*, *2 shorter ones to 7 × 1.2 cm*, *otherwise similar.* **Nuts** *ovoid*, *to 3.5 × 2.5 cm*, *with to 1 cm prominent style remnant.*

Vernacular names. Sabah—*selangan batu mata-mata* (preferred name). Sarawak—*selangan batu lubang hidung* (preferred name).

Distribution. Endemic in Borneo. Known in Sabah from Beaufort, Sipitang and Tawau districts (e.g., *SAN 15164*, *SAN 21492* and *SAN 37110*) and in Sarawak from Bintulu, Lawas and Miri districts (e.g., *S 1785*, *S 22069* and *S 24984*). Also occurring in Brunei (e.g., *BRUN 3395* and *BRUN 5666*), and NE Kalimantan.

Ecology. Scattered, usually as single mature trees, but widespread, in mixed dipterocarp forest on shale ridges, at altitudes to 700 m. Vulnerable.

34. **Shorea elliptica** Burck Fig. 23.

(Latin, *ellipticus*; the elliptic leaf blade)

(sect. **Rubella**, red meranti)

Ann. Jard. Bot. Buitenz. 6 (1887) 215; Merrill *op. cit.* (1921) 404; Masamune *op. cit.* 493; Browne *op. cit.* 138; Ashton *op. cit.* (1968) 151, *op. cit.* (1982) 500; Anderson *op. cit.* (1980) 125; PROSEA *op. cit.* 428; Newman *et al. op. cit.* (1996) 137. **Type:** *Beccari PB 2574*, Borneo, Sarawak, Matang (holotype BO).

Medium-sized emergent tree, to 40 m tall, to 1.2 m diameter, with hemispherical dense crown pale from below; bole straight; buttresses to 1.5 m tall, stout. **Bark** becoming dark mauve-brown dappled, pale grey, deeply v-section fissured; inner bark orange-brown; heartwood pink. *Twig*, *leaf bud*, *parts of perianth exposed in bud*, *stipule and bracteole outside*, *inflorescence*, *nut*, *and veins and midrib below densely ochreous to cream scabrid-puberulent*; *lateral veins above and stipule within sparsely evenly so*; *blade densely cream-lepidote below.* **Twigs** *c.* 2 mm diameter apically, terete to somewhat compressed, much-branched; stipule scars short. Leaf buds ovoid, obtuse, compressed, to 8 × 6 mm. **Stipules** narrowly ovate, acute, to 10 × 6 mm, caducous. **Leaves** *thickly coriaceous*, *drying dull greyish brown above*, *cream below*; *blade elliptic-oblong*, *7–10 × 4–9 cm*, *base broadly cuneate to subcordate*, *apex obtuse to shortly broadly acuminate*; *midrib evident but shallowly furrowed above*, *prominent*, *terete below*; *lateral veins 11–16 pairs*, *prominent below*; *intercostal venation slender*, *densely scalariform*, *more or less obscure*; *petiole 1.5–3.3 cm long.* **Inflorescences** terminal or axillary; rachis more or less compressed, to 12 cm long, singly or doubly branched, branchlets bearing to 3 flowers; bracteoles elliptic, obtuse, to 2 × 1 mm, caducous. **Flowers:** buds to 4 × 3 mm; *petals pale yellow*; *stamens 19–20*, *anthers oblong*, *almost as long as filaments*, *connectival appendage stout*, *somewhat shorter than anther*; *ovary without stylopodium*, *glabrous*, *style c. 2x as long as ovary.* **Fruits:** pedicels to 3 mm, expanding into receptacle; *calyx lobes unequal*, *3 longer lobes narrowly* *spatulate to sublorate, to 8 × 1.5 cm, tapering to 4 mm above the saccate base, 2 shorter ones to 6 × 0.8 cm, otherwise similar.* **Nuts** *ovoid, acute, to 1.5 × 1.2 cm.*

Vernacular name. Sarawak—*meranti lang* (preferred name).

Distribution. Endemic in Borneo. Known in Sarawak from Kuching and Lundu districts (e.g., *S 10059*, *S 27769*, *S 29468*, *S 37765*, and *S 49960*) and in Kalimantan from Lower Kapuas valley.

Ecology. Locally common, in mixed dipterocarp forest on leached sandy clay soils, at altitudes to 500 m. Occurring in Bako NP; elsewhere endangered.

35. **Shorea exelliptica** Meijer Plate 4A.

(Latin, *ex-* = excluded from, *elliptica* = *S. elliptica*; species formerly confused with *S. elliptica*)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

Act. Bot. Neerl. 12 (1963) 323; Meijer & Wood *op. cit.*167; Ashton *op. cit.* (1964) 132, *op. cit.* (1968) 69, *op. cit.* (1982) 455; Burgess *op. cit.* 202; Anderson *op. cit.* (1980) 119; PROSEA *op. cit.* 428; Coode *et al.* (eds.) *op. cit.* 76; Newman *et al. op. cit.* (1998)174. **Lectotype** (designated here)**:** *Rahman S 1641*, Borneo, Brunei, Belait (hololectotype K; isolectotypes KEP, L). **Synonyms:** *Shorea ?elliptica auct. non* Burck: Symington *op. cit.* (1943) 13; *S.* sp. Browne *op. cit.* 170.

Emergent tree, to 60 m tall, to 1 m diameter, with dense hemispherical crown pale from below; bole straight; buttresses to 1.5 m tall, spreading, rather thin. **Bark** becoming closely cracked, then thinly oblong flaky, the flakes becoming persistent in big trees. *Twig, inflorescence, leaf bud, parts of perianth exposed in bud, stipule, bracteole, petiole, midrib on both surfaces, and veins below densely persistently purplish brown to golden brown scabrid-pubescent, sometimes glabrescent on midrib above; ovary and nut evenly buff-pubescent.* **Twigs** ridged, at first somewhat compressed or terete, *c.* 2 mm diameter apically. Leaf buds ovoid, more or less compressed, to 3.5 × 3 mm. **Stipules** broadly ovate, acute, to 8 × 4 mm, *not at first caducous*. **Leaves** coriaceous, *golden to silver lepidote below* (mature trees), *drying purplish brown with cream undersurface, the veins and midrib dark purplish; blade oblong to broadly ovate, 9–15 × 3.5–7 cm, base broadly cuneate, apex with tapering acumen to 1 cm long; midrib prominent below, evident but furrowed above; lateral veins 12–18 pairs, prominent below; intercostal venation scalariform, slender, sinuate*; petiole 1.2–1.7 cm long, rugose. **Inflorescences** terminal or axillary; rachis ribbed and slightly compressed, to 12 cm long, singly branched, branchlets bearing to 8 flowers; bracteoles elliptic, acute, to 4 mm long, caducous. **Flowers:** buds to 10 × 3 mm; petals cream, pink at base; *stamens 30–40, filaments slightly hispid, connectival appendage as long as anther, setose*; ovary and stylopodium shortly ovoid, densely tomentose except at the base, style as long as both, slender, glabrous. **Fruits:** calyx glabrous, *lobes unequal, 3 longer lobes to 8 × 2.4 cm, tapering to 4 mm above the saccate base, 2 shorter ones to 4.5 × 1.7 cm, otherwise similar.* **Nuts** ovoid, to 1.5 × 1 cm, with to 3 mm tapering style remnant.

Vernacular name. Sabah and Sarawak—*selangan batu tembaga* (preferred name).

Distribution. Peninsular Malaysia and Borneo. In Borneo known in Sabah from Kinabatangan, Lahad Datu, Sandakan, Sipitang, and Tawau districts (e.g., *SAN 15165*, *SAN 16986*, *SAN 19559*, and *SAN A 4242*) and in Sarawak from Belaga, Kapit, Kuching, Lawas, Limbang, Marudi, and Miri districts (e.g., *S 1432*, *S 32326*, *S 38750*, *S 41230*, and *S 68994*). Also occurring in Brunei (e.g., *BRUN 880* and *BRUN 5661*) and Kalimantan (e.g., *Ambriansyah & Arifin Berau 1075* and *bb. 29311*).

Ecology. Frequent in mixed dipterocarp forest on yellow clay and sandy clay soils on the sedimentary rocks of the inland ridges, at altitudes to 600 m; and less so on undulating land in the lowlands. Occurring in Lambir and Mulu NPs; elsewhere vulnerable owing to logging.

36. **Shorea faguetiana** F.Heim

(Faguet, 19th century French botanical assistant at Paris)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Bull. Mens. Soc. Linn. Paris 2 (1891) 975; Merrill *op. cit.* (1921) 414; Symington, Gard. Bull. S. S. 7 (1933) 148, *op. cit.* (1939) 381, *op. cit.* (1943) 50; Masamune *op. cit.* 493; Browne *op. cit.* 162; Ashton *op. cit.* (1964) 152, *op. cit.* (1968) 83, *op. cit.* (1982) 484; Meijer & Wood *op. cit.* 69; Burgess *op. cit.* 217; Anderson *op. cit.* (1980) 121; PROSEA *op. cit.* 418; Coode *et al.* (eds.) *op. cit.* 76; Newman *et al. op. cit.* (1996) 138. **Lectotype** (designated here)**:** *Beccari PB 2491*, Borneo, Sarawak, Matang (hololectotype P).

Large emergent tree, to 50 m tall, to 1.5 m diameter, with straight bole and dense hemispherical crown; buttresses to 1.5 m tall, stout. **Bark** fawn-brown, vertically cracked and thinly oblong flaky; dammar coxcombs present, dark greyish brown. *Leaf bud*, *parts of perianth exposed in bud*, *young twig*, *inflorescence*, *stipule*, *and bracteole pale greyish brown puberulent*; *young leaves fugaceous puberulent below*; *ovary*, *stylopodium*, *and nut densely cream buff pubescent.* **Twigs** *c.* 1 mm diameter apically, slender, rugulose, lenticellate. Leaf buds ovoid to conical, *c.* 2 × 1.5 mm, small. **Stipules** hastate, to 4 × 1.5 mm. **Leaves** *coriaceous*, *drying greyish green*; *blade elliptic to oblong-lanceolate or ovate*, *7–12 × 3–5 cm*, *base cuneate to obtuse*, *equal or subequal*, *apex with tapering acumen to 1 cm long*; *midrib raised and terete below*, *evident and shallowly furrowed to flat above*; lateral veins 9–12 pairs; *intercostal venation rather dense*, *subscalariform*, *slightly elevated*; *petiole 1–1.5 cm long*, *fairly stout.* **Inflorescences** terminal or axillary, rachis lax, terete, to 20 cm long, doubly or trebly branched, branchlets bearing to 8 flowers; bracteoles small, fugaceous. **Flowers:** buds small, to 3 mm long; petals cream; *stamens 15*, *connectival appendage as long as anther*, *sericeous towards apex*; *ovary subglobose*, *stylopodium as long as ovary*, *style short*, *glabrous.* **Fruits:** calyx sparsely puberulent, *lobes unequal*, *3 longer lobes to 6 × 1.2 cm*, *tapering to 2.5 mm above the tuberculate saccate base*, *2 shorter ones to 4.5 cm long*, *narrower*, *otherwise similar.* **Nuts** *narrowly ellipsoid to obovoid*, *acute*, *to 1.5 × 0.5 cm.*

Vernacular names. Sabah—*seraya kuning siput* (preferred name). Sarawak—*lun siput* (preferred name).

Distribution. SE Peninsular Thailand, Peninsular Malaysia and Borneo. In Borneo, occur throughout Sabah and recorded from Beaufort, Keningau, Kinabatangan, Sandakan, Sipitang, Tawau, and Tenom districts (e.g., *SAN 15143*, *SAN 22789*, *SAN 36401*, *SAN 61239*, *SAN 63063*, and *SAN 68597*) and in Sarawak from Bau, Belaga, Bintulu, Kapit, Kuching, Lawas, Limbang, Lundu, Simunjan, and Tatau districts (e.g., *S 15221*, *S 22485*, *S 27122*, *S 29635*, and *S 49931*). Also occurring in Brunei (e.g., *BRUN 3019* and *BRUN 3178*) and E Kalimantan (e.g., *Arifin et al. Berau 710* and *Arifin* and *Ambriansyah Berau 1040*).

Ecology. Widespread and frequent, in mixed dipterocarp forest on well-drained clay and sandy clay soils, at altitudes to 1000 m. Well represented in Kubah, Lambir and Mulu NPs; probably not vulnerable.

37. **Shorea faguetioides** P.S.Ashton

(Greek, *-oides* = resembling; similar to *S. faguetiana*)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. Sing. 19 (1962) 287, *op. cit.* (1964) 154, *op. cit.* (1968) 83, *op. cit.* (1982) 480; Meijer & Wood *op. cit.* 80; Anderson *op. cit.* (1980) 122; Coode *et al.* (eds.) *op. cit.* 77; Newman *et al. op. cit.* (1996) 139. **Type:** *Drahman S 1771*, Borneo, Sarawak, Lawas, Bt. Pengalih (holotype K; isotype KEP).

Large emergent tree, to 50 m tall, to 1.4 m diameter, with straight cylindrical bole and dense hemispherical crown. **Bark** pale greyish tawny, shallowly cracked and evenly flaky, appearing smooth overall; dammar in greyish coxcombs, black within. *Inflorescence and parts of perianth exposed in bud persistently greyish brown puberulent*; *ovary*, *stylopodium and nut densely buff puberulent*; *young twig sometimes caducously so*; *parts otherwise glabrous.* **Twigs** *c.* 3 mm diameter apically, somewhat compressed at first, drying blackish, rugulose. Leaf buds ovoid, obtuse, compressed, 3–4 × 2.5 mm. **Stipule** *narrowly deltoid*, *saccate*, *obtuse*, *to 18 × 6 mm*, *not at first caducous*. **Leaves** *brilliant magenta when opening*, *chartaceous*, *drying tawny-brown lustrous below with darker midrib*; *blade narrowly ovate*, *12–18 × 5–7 cm*, *base subequal*, *broadly cuneate to subcordate*, *apex with prominent acumen to 2 cm long*; *midrib evident*, *flat or shallowly furrowed above*, *prominent below*; *lateral veins 10–15 pairs*, *slender but distinctly raised below*, *arched*; *intercostal venation scalariform*, *slender*, *evident*; *petiole 2.2–3 cm long*, *c. 2 mm diameter*, *slender*, *drying black*, *weakly geniculate.* **Inflorescences** terminal or axillary; rachis terete, lax, to 15 cm long, doubly or sometimes trebly branched, branchlets bearing to 7 flowers; bracteoles small, fugaceous. **Flowers:** buds to 2.5 × 1.5 mm; *petals cream*; *stamens 15*, *connectival appendage c. 3x the length of anther*, *sericeous towards apex*; *ovary ovoid*, *stylopodium shorter than ovary*, *cylindrical*, *style short*, *glabrous.* **Fruits:** calyx puberulent towards base, otherwise glabrous, *lobes unequal*, *chartaceous*, *3 longer lobes to 7 × 1.5 cm*, *tapering to 4 mm above narrow saccate tuberculate base*, *2 shorter ones to 5 × 0.7 cm*, *otherwise similar*. **Nuts** *ellipsoid to obovoid*, *to 2 × 0.6 cm*, *with 3 mm slender style remnant*.

Vernacular names. Sabah—*seraya kuning* (preferred name). Sarawak—*barek* (Iban).

Distribution. Endemic in Borneo. In Sabah known from Beaufort, Keningau and Kota Kinabalu districts (e.g., *SAN 16242*, *SAN 38713* and *SAN 66242*) and in Sarawak from Belaga, Bintulu, Kapit, Lawas, Limbang, Lundu, Miri, Simunjan, and Tatau districts (e.g., *S 23743*, *S 25025* and *S 27004*). Also occurring in Brunei (e.g., *BRUN 3340* and *BRUN 5645*) and W Kalimantan (e.g., *bb. 29609* and *bb. 29610*).

Ecology. Locally frequent in mixed dipterocarp forest on clay-rich soils, on shale and volcanic rocks, at altitudes to 700 m. Occurring in Lambir NP; elsewhere vulnerable owing to land conversion.

38. **Shorea falcifera** Dyer *ex* Brandis

(Latin, *falx* = a sickle, *ferre* = to bear; carrying a sickle, the sickle-shaped leaf)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

J. Linn. Soc. Bot. 31 (1895) 64; Merrill *op. cit.* (1921) 571; Ashton *op. cit.* (1978) 36, *op. cit.* (1982) 456; PROSEA *op. cit.* 428; Newman *et al. op. cit.* (1998) 177. **Type:** *Beccari PB 3046*, Borneo, Sarawak, Santubong (holotype K). **Synonyms:** *Hopea linggensis* Boerl., Cat. Hort. Bog. 2 (1901) 105; *Shorea flava* Meijer *op. cit.* 325, Ashton *op. cit.* (1968) 69, Anderson *op. cit.* (1980) 119.

Emergent tree, to 45 m tall, to 1.4 m diameter, with sea-green diffuse hemispherical crown; bole straight; buttresses to 1.5 m tall, fairly thin. **Bark** yellowish brown, patchily becoming rich reddish brown, cracked and patchily oblong flaky. *Twig*, *bud*, *stipules* (*sparsely so within*) *venation*, *and blade below densely persistently pale yellow lepidote*; *inflorescence*, *parts of perianth exposed in bud and nut densely persistently buff-puberulent*; *fruit calyx sparsely caducously so*; *ovary and stylopodium sericeous.* **Twigs** *c.* 1 mm diameter apically, slender, terete. Leaf buds small, elliptic, subacute, to 2 × 1 mm. **Stipules** elliptic, obtuse, to 6 × 4 mm, fugaceous. **Leaves** *coriaceous*, *drying mauve-grey above*, *cream below*; *blade narrowly ovate- to lanceolate-falcate*, *6.5–12 × 2.5–5 cm*; *midrib shallowly sunken*, *slender but evident above*, *prominent below*; *lateral veins c. 10 pairs*, *slender but slightly raised below*; *intercostal venation obscure*, *scalariform*; *petiole slender*, *somewhat geniculate*, *1.1–1.8 cm long*. **Inflorescences** terminal or axillary; rachis terete or ribbed, to 11 cm long, singly branched, branchlets bearing to 5 flowers. **Flowers:** buds to 8 × 2 mm; petals cream; *stamens 33–34*, *filaments setose*, *anthers sparsely so on distal margin*, *connectival appendage shorter than anther*, *shortly setose*; *ovary and stylopodium pyriform*, *style short*, *glabrous*. **Fruits:** *calyx lobes unequal*, *3 longer lobes to 9.5 × 1.8 cm*, *tapering to 7 mm above the saccate base*, *2 shorter ones to 7 × 0.8 cm*, *otherwise similar*. **Nuts** ovoid, to 2.5 × 1.5 cm, with to 7 mm prominent filiform style remnant.

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo known in Sarawak from Kuching, Lundu, Simunjan, and Sri Aman districts (e.g., *S 10288*, *S 15433*, *S 25291*, *S 58976*, and *S 68888*).

Ecology. Common in mixed dipterocarp forest on sandy soils on hills, often rocky, near the sea, at altitudes to 200 m. Occurring in Bako NP; vulnerable outside parks system.

39. **Shorea falciferoides** Foxw.

(Greek, *-oides* = resembling; similar to *S. falcifera*)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

Philip. J. Sci. 13 (1918) Bot. 189. **Lectotype** (designated here)**:** *Mayor FB 25664*, the Philippines, Luzon, Zambales Province, Masinloc (hololectotype K). **Synonym:** *Shorea gisok* Foxw., *op. cit.* (1938) 294.

Notes. Two subspecies, subsp. *falciferoides* and subsp. *glaucescens* are recognised, of which the former is endemic in the Philippines.

subsp. **glaucescens** (Meijer) P.S.Ashton

Gard. Bull. Sing. 31 (1978) 37, *op. cit.* (1982) 458; PROSEA *op. cit.* 428; Coode *et al.* (eds.) *op. cit.* 77; Newman *et al. op. cit.* (1998) 178. **Basionym:** *Shorea glaucescens* Meijer *op. cit.* 327, Meijer & Wood *op. cit.* (1964) 170, Ashton *op. cit.* (1964) 134, *op. cit.* (1968) 71, Burgess *op. cit.* 202, Anderson *op. cit.* (1980) 119. **Type:** *G.H.S. Wood* & *Agama SAN 15484*, Borneo, Sabah, Sepilok FR (holotype K; isotype KEP).

Emergent tree, to 50 m tall, to 1.1 m diameter; crown sparse, irregularly hemispherical; bole straight or misshapen; buttresses to 3 m tall, spreading, thin. **Bark** reddish brown, becoming cracked and irregularly oblong flaky. *Young twig*, *inflorescence*, *petiole*, *leaf bud*, *stipules*, *bracteole*, *parts of perianth exposed in bud*, *ovary*, *stylopodium*, *and nut densely evenly persistently cream puberulent*; *fruit calyx sparsely so towards base.* **Twigs** 2–3.5 mm diameter apically, terete or somewhat compressed and ribbed; stipule scars *c.* 1.5 mm long, pale, horizontal. Leaf buds globose to ovoid, subacute, slightly compressed, to 5 × 3.5 mm. **Stipules** obtuse, to 10 × 4 mm, fugaceous. **Leaves** *chartaceous*, *drying pale tawny above*, *cream below*; *blade broadly ovate-falcate*, 10–18 × 4.5–8 cm, *base subequal*, *obtuse to cuneate*, *apex with tapering acumen c. 0.8 cm long*; *midrib evident*, *flat to shallowly furrowed above*, *prominent below*; *lateral veins 8–12 pairs*, *slender*, *well-spaced*, *ascending*, *raised but not prominent below*; *intercostal venation slender*, *densely scalariform*, *not raised*; *petiole 1.5–2 cm long*, *stout.* **Inflorescences** terminal or axillary; rachis ribbed and somewhat compressed, to 4 cm long, singly branched, branchlets bearing to 6 close flowers; bracteoles elliptic, to 3 mm long, fugacious. **Flowers:** buds to 5 × 2.5 mm; petals cream; *stamens c. 45*, *filaments and anthers glabrous*, *connectival appendage very short*, *stout*, *shortly setose with one long apical bristle*; *ovary and stylopodium ovoid*, *style short*, *glabrous.* **Fruits:** *calyx lobes unequal*, *3 longer lobes to 9.5 × 2.5 cm*, *tapering to 5 mm broad above the saccate base*, *2 shorter ones to 7 × 1 cm*, *otherwise similar*. **Nuts** broadly ovoid, to 1.5 × 1.5 cm, with to 4 mm tapering style remnant.

Vernacular names. Sabah—*selangan batu laut* (preferred name). Sarawak—*selangan batu daun nipis* (preferred name).

Distribution. Endemic in Borneo; widespread but absent from the W and SW parts. In Sabah known from Beaufort, Beluran, Kudat, and Sandakan districts (e.g., *SAN 16423*, *SAN 16523*, *SAN 16962*, *SAN 25439*, and *SAN 61155*) and in Sarawak from Belaga, Bintulu, Kapit, Lawas, Limbang, and Miri districts (e.g., *S 14741*, *S 27130*, *S 29677*, *S 32312*, and *S 43355*). Also occurring in Brunei (e.g., *BRUN 795*, *BRUN 5718*, *KEP 80140*, and *S 2116*) and in E Kalimantan (e.g., *Ambriansyah Berau 981* and *bb. 29684*).

Ecology. Locally frequent in mixed dipterocarp forest on clay-rich soils, at altitudes to 600 m, especially on moist slopes. Occurring in Lambir NP and Sepilok FR; elsewhere vulnerable owing to conversion of its habitat.

40. **Shorea fallax** Meijer

(Latin, *fallax* = deceptive; not at first clearly distinguished from *S. scaberrima*)

(sect. **Brachypterae**, red meranti)

Act. Bot. Neerl. 12 (1963) 335; Meijer & Wood *op. cit.* 105; Ashton *op. cit.* (1964) 186, *op. cit.* (1968) 107, *op. cit.* (1982) 516; Burgess *op. cit.* 184; Anderson *op. cit.* (1980) 125; PROSEA *op. cit.* 394; Coode *et al.* (eds.) *op. cit.* 77; Newman *et al*. *op. cit.* (1996) 140. **Lectotype** (designated here)**:** *G.H.S. Wood SAN A 1734*, Borneo, Sabah, Beaufort Hill (hololectotype K; isolectotypes KEP, L). **Synonyms:** *Shorea squamata auct. non* Benth. & Hook.*f.*: Browne *op. cit.* 144; *S. oleosa* Meijer *op. cit.* 338, Meijer & Wood *op. cit.* 124, Burgess *op. cit.* 183.

Emergent tree, to 50 m tall, to 1.3 m diameter but usually smaller; crown dense, hemispherical; bole straight, cylindrical; buttresses to 2 m tall, stout. **Bark** warm brown, deeply cracked and becoming oblong flaky; inner bark dull reddish brown; heartwood pink. *Young twig*, *inflorescence*, *leaf bud*, *parts of perianth exposed in bud*, *stipule and bracteole outside*, *petiole*, *leaf below*, *and midrib above sparsely persistently pale brown scabrid-pubescent*; *ovary*, *stylopodium and nut densely evenly buff-pubescent.* **Twigs** *2–2.5 mm diameter apically*, *terete*, *ribbed below the c. 2 mm long pale subfalcate stipule scars*. *Leaf buds ovoid*, *subacute*, *5–8 × 4–6 mm*, *large.* **Stipules** *hastate*, *to 15 × 5 mm*, *caducous.* **Leaves** *coriaceous*, *drying chocolate-brown below*, *mauve-grey above*; *blade broadly oblong to ovate*, *12–24 × 5.5–11 cm*, *base obtuse*, *apex with tapering acumen to 1.2 cm long*; *midrib evident*, *flat above*, *prominently terete below*; *lateral veins 15–19 pairs*, *prominent below*, *arched*, *generally with many short intermediate veins*; *intercostal venation scalariform*, *distant*, *prominent below*; *petiole 1–1.5 cm long.* **Inflorescences** terminal or axillary; rachis terete or ribbed, lax, to 22 cm long, singly or doubly branched, branchlets bearing to 7 flowers; *bracteoles ovate*, *acute*, *to 7 × 3 mm*, *not at first caducous.* **Flowers:** buds to 8 × 4 mm; petals cream-yellow; *stamens 15*, *connectival appendage c. 2x the length of anther*; *ovary and stylopodium pyriform*, *style equally long*, *columnar*, *glabrous.* **Fruits** subsessile; calyx glabrescent, *lobes unequal*, *3 longer lobes to 5 × 0.8 cm*, *tapering to 3.5 mm broad above the saccate base*, *2 shorter ones linear-lobed*, *to 2.5 × 0.15 cm*, *similar at base*. **Nuts** *ovoid*, *to 2.7 × 1 cm*, *apiculate*.

Vernacular names. Sabah—*seraya daun kasar* (preferred name). Sarawak—*engkabang pinang* (Iban), *engkabang layar* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Beaufort, Keningau, Kinabatangan, Labuk Sugut, Sandakan, and Tawau districts (e.g., *SAN 16466*, *SAN 28687*, *SAN 36910*, *SAN 61257*, and *SAN 123774*) and in Sarawak from Belaga, Bintulu, Kapit, Lawas, Lundu, Marudi, Miri, and Tatau districts (e.g., *S 15113*, *S 22386*, *S 31702*, *S 46429*, and *S 53496*). Also occurring in Brunei (e.g., *BRUN 769* and *BRUN 3065*) and Kalimantan (e.g., *Endert 4783*).

Ecology. Frequent in mixed dipterocarp forest, on clay soils mostly over shale, on moist hillsides, low hills and alluvium, at altitudes to 600 m. Occurring in Danum Valley Conservation Area and Sepilok FR in Sabah and Lambir and Mulu NPs in Sarawak; elsewhere vulnerable owing to forest conversion.

41. **Shorea ferruginea** Dyer *ex* Brandis

(Latin, *ferrugineus* = rust-coloured; the dry leaf)

(sect. **Mutica**, subsect. **Auriculatae**, red meranti)

J. Linn. Soc. Bot. 31 (1895) 91; Merrill *op. cit.* (1921) 405; Masamune *op. cit.* 493; Browne *op. cit.* 139; Ashton *op. cit.* (1964) 187, *op. cit.* (1968) 108, *op. cit.* (1982) 533; Meijer & Wood *op. cit.* 106; Burgess *op. cit.* 184; Anderson *op. cit.* (1980) 125; PROSEA *op. cit.* 394; Coode *et al.* (eds.) *op. cit.* 77; Newman *et al. op. cit.* (1996) 142. **Type:** *Beccari PB 2604*, Borneo, Sarawak, Matang (holotype K).

Emergent tree, to 45 m tall, to 1.6 m diameter, with diffuse hemispherical, cauliflower-shaped crown; bole straight, cylindrical; buttresses to 3.5 m tall, stout. **Bark** smooth at first, becoming yellowish fawn, shallowly v-section fissured and powdery thinly oblong flaky, occasionally becoming somewhat shaggy; inner bark and heartwood yellowish brown. *Young twig*, *inflorescence*, *leaf bud*, *parts of perianth exposed in bud*, *stipule and bracteole outside* (*sparsely so within*), *petiole*, *and blade below persistently pale brown scabrid-puberulent*; *ovary*, *stylopodium and nut sparsely cream buff pubescent.* **Twigs** 2–2.5 mm diameter apically, terete, ribbed below the short pale falcate stipule scars. Leaf buds ovoid, subacute, 5–8 × 4–6 mm. **Stipules** hastate, acute, to 15 × 5 mm. **Leaves** *thinly coriaceous*, *drying dull orange-brown below*, *paler above*; *blade broadly oblong to ovate-lanceolate*, *6–15 × 3.3–5.3 cm*, *base obtuse*, *apex with slender acumen to 1.2 cm long*; *midrib obscure*, *sunken above*, *prominent below*; *lateral veins 11–14 pairs*, *slender and hardly raised below*; *intercostal venation slender*, *scalariform*, *obscure*; *petiole 1–1.5 cm long.* **Inflorescences** terminal or axillary; rachis terete or ribbed, lax, to 22 cm long, singly or doubly branched, branchlets bearing to 7 flowers; bracteoles ovate, acute, to 7 × 3 mm, fugaceous. **Flowers:** stamens 15, *connectival appendage curved but not becoming fully reflexed*; *ovary and stylopodium pyriform*, *style equally long*, *columnar*, *glabrous.* **Fruits** subsessile; calyx glabrescent; *lobes unequal*, *3 longer lobes to 12 × 3.5 cm*, *tapering to to 1.3 cm at the auriculate base*, *saccate at the incrassate centre*, *2 shorter ones linear-lobed*, *to 4 × 0.8 cm*, *hardly auriculate at base.* **Nuts** *ovoid*, *to 2.7 × 1 cm*, *prominently apiculate.*

Vernacular names. Sabah—*seraya melantai kecil* (preferred name). Sarawak— *engkabang kali* (Iban), *meranti menalit* (preferred name).

Distribution. Endemic in Borneo; widespread. In Sabah recorded from Beaufort, Kota Merudu, Labuk Sugut, Nabawan, Ranau, and Tenom districts (e.g., *SAN 15089*, *SAN 16363*, *SAN 94903*, *SAN 99272*, and *SAN 99547*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lawas, Lubok Antu, Miri, and Samarahan districts (e.g., *S 10703*, *S 15833*, *S 29640*, *S 36929*, and *S 68123*). Also occurring in Brunei (e.g., *BRUN 422* and *BRUN 3396*).

Ecology. Locally common in mixed and upper dipterocarp forests on dry sandy clay and skeletal clay soils, especially on ridges, at altitudes to 1100 m. Occurring in Kinabalu, Lambir and Mulu NPs; not vulnerable.

42. **Shorea flaviflora** Wood *ex* P.S.Ashton

(Latin, *flavus* = yellow, *flos* = flower; yellow-flowered)

(sect. **Brachypterae**, subsect. **Brachypterae**, red meranti)

Gard. Bull. Sing. 19 (1962) 289, *op. cit.* (1964) 188, *op. cit.* (1968) 108, *op. cit.* (1982) 518; Meijer & Wood *op. cit.* 107; Anderson *op. cit.* (1980) 126; Coode *et al.* (eds.) *op. cit.* 77; Newman *et al. op. cit.* (1996) 518. **Type:** *G.H.S. Wood SAN 15109*, Borneo, Sabah, Beaufort, Pangi (holotype KEP; isotype L).

Emergent tree, to 45 m tall, to 1.4 m diameter, with irregular crown; bole cylindrical or frequently misshapen; buttresses to 4 m tall, stout. **Bark** dark brown to blackish, becoming deeply v-section fissured and eventually thinly flaky, with occasional cream dammar smears; inner bark rich crimson; heartwood dark yellowish brown. *Young parts shortly pale grey puberulent with minute adpressed hair-tufts*, *caducous except on inflorescence*, *leaf bud*, *stipule*, *and parts of perianth exposed in bud*; *ovary*, *stylopodium and nut densely buff pubescent.* **Twigs** 2–3 mm diameter apically, terete, glabrous, smooth; *stipule scars narrow*, *pale*, *ascending*, *half encircling twig. Leaf buds falcate*, *acute*, *6–12 × 1.5–3 mm.* **Stipules** *narrowly hastate*, *to 24 × 7 mm*, *caducous.* **Leaves** *thinly coriaceous*, *undulate*, *drying rich fawn-brown below with paler veins*, *pale tawny above*; *blade narrowly ovate*, *12–18 × 5.5–7 cm*, *base broadly cuneate to obtuse*, *apex tapering to c. 1.5 cm slender acumen*; *midrib flat*, *evident above*, *prominent below*; *lateral veins 6–7 pairs*, *ascending*, *arched*, *slender but prominent below*, *with small pore-like axillary domatia*; *intercostal venation very slender*, *hardly raised*, *densely scalariform*; *petiole 2–3 cm long*, *geniculate.* **Inflorescences** terminal or axillary, pendent; rachis terete, to 15 cm long, doubly branched, branchlets bearing to 12 flowers; bracteoles elliptic, obtuse, to 5 × 2.5 mm, fugaceous. **Flowers:** buds large, to 14 × 4.5 mm; *petals rich yellow*; stamens 15, *anthers large*, *reniform*, *locules indistinct*, *connectival appendage c. 3x the length of anther*; *ovary and stylopodium pyriform*, *style filiform*, *as long as ovary and stylopodium*, *glabrous.* **Fruits:** calyx glabrous, *lobes unequal*, *3 longer lobes to 13 × 3 cm*, *tapering to 11 mm above the saccate base*, *2 shorter ones to 8 × 1.3 cm*, *otherwise similar.* **Nuts** *ovoid*, *to 2.5 × 1.3 cm*, *with tapering style remnant to 1 cm long.*

Vernacular names. Sabah—*seraya daun besar* (preferred name). Sarawak—*selangan merah bukit* (preferred name).

Distribution. Endemic in Borneo; known in Sabah from Beaufort, Ranau, Sipitang, Tambunan, and Tenom districts (e.g., *SAN 15098*, *SAN 16389*, *S 23484*, *SAN 24817*, and *SAN 69870*) and in Sarawak from Bintulu, Kapit, Limbang, and Tatau districts (e.g., *S 17764*, *S 29181*, *S 48960*, *S 53677*, and *S 64905*). Also occurring in Brunei (e.g., *BRUN 5276* and *BRUN 5664*).

Ecology. Locally frequent in mixed dipterocarp but especially upper dipterocarp forest on high shale ridges, at (150–)400–1300 m altitude. Occurring in Kinabalu and Mulu NPs; elsewhere vulnerable owing to logging.

43. **Shorea flemmichii** Symington

(C.O. Flemmich, Forestry Officer in Peninsular Malaysia, who served in Brunei 1938–1941 and collected important dipterocarp types)

(sect. **Brachypterae**, subsect. **Brachypterae**, red meranti)

Gard. Bull. S. S. 10 (1939) 378; Masamune *op. cit.* 493; Browne *op. cit. l.c.* 147; Ashton *op. cit.* (1964) 190, *op. cit.* (1968) 108, *op. cit.* (1982) 507; Anderson *op. cit.* (1980) 126; PROSEA *op. cit.* 395; Coode *et al.* (eds.) *op. cit.* 77; Newman *et al. op. cit.* (1996) 144. **Type:** *Flemmich FMS 32585*, Borneo, Brunei, Belait district, Tenajor, Bt. Rotan (holotype KEP; isotype KEP).

Magnificent emergent tree, to 60 m tall, to 2.5 m diameter, with vast cauliflower-shaped crown suffused golden brown from below; bole tall, cylindrical; buttresses to 1.5 m tall, stout. **Bark** purplish grey, black and ochre-mottled, becoming densely deeply v-section fissured, the intervening ridges oblong-flaky; dammar in prominent ochre-yellow smears; inner bark deep crimson; heartwood reddish rust. *Young twig*, *inflorescence*, *leaf bud*, *parts of perianth exposed in bud*, *stipule and bracteole outside*, *petiole*, *midrib below and at base above*, *and venation below densely persistently golden tawny scabrid-tomentose*; *leaf above scabrid-puberulent*; *ovary and nut buff-pubescent.* **Twigs** stout though tapering to 2 mm diameter apically, much branched, terete, verruculose. Leaf buds ovoid, subacute, slightly compressed, 3–6 × 2–4 mm. **Stipules** narrowly hastate, acute, to 8 × 2.5 mm, fugaceous. **Leaves** *coriaceous*, *cream lepidote below*, *otherwise drying chocolate-brown*; *blade broadly elliptic or ovate* (*young trees*), *5–9 × 3–4.5 cm*, *base obtuse*, *margin revolute*, *apex with narrow acumen to 0.5 cm long*; *lateral veins 14–17 pairs*, *dense*, *prominent below*; *intercostal venation scalariform*, *sinuate*; *petiole 0.7–0.9 cm long*, *stout.* **Inflorescences** terminal or axillary; rachis terete or slightly compressed, to 8 cm long, singly or doubly irregularly branched, branchlets somewhat zig-zag, bearing to 8 flowers; bracteoles suborbicular, obtuse, to 6 × 5 mm, caducous. **Flowers:** buds subglobose, to 4.5 × 3.5 mm; *corolla dark crimson*; stamens 15, connectival appendage *c.* 3x the length of anther; *ovary and stylopodium ovoid-conical*, *style filiform*, *glabrous*, *as long as ovary.* **Fruits** subsessile; calyx puberulent, *calyx lobes unequal*, *3 longer lobes to 6.5 × 1.5 cm*, *tapering to 2.5 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 2 × 0.15 cm*, *similar at base.* **Nuts** ovoid, to 1.5 × 1 cm, subacute,

Vernacular name. Sarawak—*meranti raya* (preferred name).

Distribution. Endemic in Borneo. In Sarawak known from Kuching, Lawas, Miri, Samarahan, and Simunjan districts (e.g., *S 6525*, *S 16753* and *SFN 10246*).

Ecology. Very local and rare or scattered in mixed dipterocarp forest on deep yellow sands, at altitudes below 400 m. Well represented in Lambir NP; elsewhere critically endangered.

44. **Shorea foraminifera** P.S.Ashton

(Latin, *foramen* = opening, *ferre* = to bear; the prominent pore-like leaf domatia)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

Gard. Bull. Sing. 22 (1967) 295, *op. cit.* (1968) 108, *op. cit.* (1982) 538; Anderson *op. cit.* (1980) 126; Coode *et al.* (eds.) *op. cit.* 77; Newman *et al. op. cit.* (1996) 143. **Type:** *Sabli S 1916*, Borneo, Brunei, Andulau FR (holotype K; isotype KEP).

Emergent tree, to 50 m tall, to 1.2 m diameter; bole straight, cylindrical; buttresses to 1 m tall, stout. **Bark** pinkish brown, prominently v-section fissured; inner bark pinkish brown; heartwood deep pink. *Young parts*, *leaf and stipules excepted*, *fugaceous puberulent*; *calyx sparsely puberulent towards base*; *nut persistently sericeous*, *known parts otherwise glabrous.* **Twigs** at first slightly compressed, 1–2 mm diameter apically. Leaf buds ovoid, compressed, subacute, to 8 × 5 mm. **Stipules** oblong to elliptic, obtuse, to 10 × 5 mm, caducous. **Leaves** *coriaceous*, *drying warm brown below*, *greyish brown above*; *blade broadly ovate*, *6–9 × 4–7 cm*, *base cordate to obtuse*, *apex with somewhat falcate acumen to 0.5 cm long*; *midrib obscure and slightly sunken above*, *prominent*, *terete*, *below*; *lateral veins 8–9 pairs*, *prominent below*, *arched*, *with prominent pustular porous domatia*; *intercostal venation very slender*, *scalariform*, *hardly raised*; *petiole 1–1.5 cm long.* **Inflorescences** and **flowers** unknown. **Fruits:** pedicels *c.* 1 mm long; calyx lobes puberulent towards base, unequal, 3 longer lobes to 7 × 1.2 cm, tapering to *c.* 4 mm above the saccate base, 2 shorter ones lorate-lobed, to 4.5 × 0.4 cm, similar at base. **Nuts** ovoid, to 1.5 × 1 cm, shortly apiculate.

Vernacular name. Sarawak—*meranti lubang hidung* (preferred name).

Distribution. Endemic in Borneo. Rare, known definitely from Brunei (e.g., *BRUN 243*, *FMS 28659*, *FMS 28675*, *S 1916*, and *SAN 17531*). Fallen leaves observed at Similajau FR, Bintulu district and Ulu Arip, Mukah district in Sarawak.

Ecology. Occasional, in small groups on periodically flooded sandy alluvium, including shallow peat, at low altitude. Critically endangered.

45. **Shorea foxworthyi** Symington

(F.W. Foxworthy, 1877–1950, first research officer at the Forest Research Institute, Kepong, Malaysia)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

Gard. Bull. S. S. 8 (1935) 272, *op. cit.* (1943) 14; Keith *op. cit.* 44; Meijer & Wood *op. cit.* 169; Burgess *op. cit.* 202; Ashton *op. cit.* (1968) 70, *op. cit.* (1982) 453; Anderson *op. cit.* (1980) 119; PROSEA *op. cit.* 428; Coode *et al.* (eds.) *op. cit.* 77; Newman *et al. op. cit.* (1998) 179. **Type:** *Foxworthy KEP 9507*, Peninsular Malaysia, Pahang, Baloh FR (holotype KEP).

Large emergent tree, to 60 m tall, to 1.2 m diameter, with dense irregularly hemispherical crown; bole straight, cylindrical; buttresses to 3 m tall, slender, spreading. **Bark** greyish fawn, becoming irregularly cracked then shallowly flaked, and eventually shaggy leaving scroll-marked surfaces below. *Twig*, *inflorescence*, *leaf bud*, *parts of perianth exposed in bud*, *stipule outside*, *and petiole densely shortly evenly golden-tawny velutinous*; *leaf venation below*, *and inside of stipules and bracteoles sparsely so*, *caducous on venation*. **Twigs** *somewhat compressed*, *c*. 2 × 3 mm apically. Leaf buds ellipsoid, obtuse, to 3 × 2 mm. **Stipules** narrowly elliptic to falcate, subacute, to 15 × 4 mm, caducous. **Leaves** *coriaceous*, *drying tawny-brown below*; *blade somewhat bullate in between lateral veins*, *elliptic*, *8–13 × 3–6.5 cm*, *base broadly cuneate*, *subequal*, *apex with broad acumen to 1 cm long*; *midrib evident but somewhat sunken above*, *prominent below*; *lateral veins 10–14 pairs*, *ascending*, *arched*, *prominent below*; *intercostal venation slender*, *densely scalariform*; *petiole 1.1–2 cm*, *drying rugose*, *velutinous*. **Inflorescences** terminal or axillary; rachis to 5 cm long, singly branched, branchlets bearing to 3 secund flowers; bracteoles not seen. **Flowers:** buds to 10 × 3 mm; petals cream with a pink base; *stamens 32–41*, *filaments densely setose*, *anther with sparsely setose distal margin*, *connectival appendage densely setose*, *hardly exceeding anther*; *ovary ovoid*, *stylopodium conical*, *glabrous*, *filiform*, *as long as ovary*. **Fruits:** *calyx lobes unequal*, *3 longer lobes to 10 × 2.5 cm*, *tapering to 7 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 8 × 1 cm*, *similar at base*. **Nuts** *ovoid*, *to 2.5 × 1.4 cm*, *with prominent tapering style remnant to 6 mm long*.

Vernacular names. Sabah—*selangan batu bersisik* (preferred name). Sarawak—*selangan batu bukit* (Malay).

Distribution. Sumatra, extreme SE Peninsular Thailand, Peninsular Malaysia, and Borneo. In Sabah known from Lahad Datu, Sandakan, Sipitang, and Tawau districts (e.g., *SAN*

15183, *SAN 19686* and *SAN 36224*); and in Sarawak from Bintulu, Kapit, Lawas, Marudi, Miri, and Simunjan districts (e.g., *S 4640*, *S 15149*, *S 18380*, *S 19577*, and *S 29622*). Also occurring in Brunei (e.g., *BRUN 676*) and Kalimantan (e.g., *Wilkie 94306*).

Ecology. Uncommon in mixed dipterocarp forest on yellow clay and sandy clays soils, at altitudes to 700 m. Occurring in Lambir NP; elsewhere endangered owing to the loss of its natural habitat.

46. **Shorea geniculata** Symington *ex* P.S.Ashton

(Latin, *geniculatus* = kneed; the petiole)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

Gard. Bull. Sing. 19 (1962) 291, *op. cit.* (1964) 133, *op. cit.* (1968) 71, *op. cit.* (1982) 451; Anderson *op. cit.* (1980) 119; PROSEA *op. cit.* 429; Coode *et al.* (eds.) *op. cit.* 77; Newman *et al. op. cit.* (1998) 180. **Type:** *Ashton BRUN 3264*, Borneo, Brunei, Andulau FR (holotype K; isotypes KEP, L).

Large emergent tree, to 50 m tall, to 1.8 m diameter; crown irregularly hemispherical, pale from below; bole straight, cylindrical; *buttresses stout*. **Bark** dark yellowish brown, vertically cracked and irregularly flaked, sometimes becoming shaggy. *Inflorescence*, *bracteoles*, *parts of perianth exposed in bud*, *ovary*, *stylopodium*, *and fruit densely persistently greyish-buff puberulent*; *vegetative parts glabrous.* **Twigs** stout, terete, much-branched, *c.* 3 mm diameter apically, *with swollen nodes*. *Leaf buds linear-falcate*, *4–7 × 1–1.5 mm*. **Stipules** *narrowly oblong*, *acute*, *to 10 × 3 mm*, *caducous*. **Leaves** *coriaceous*, *drying cream lepidote below with black venation*; *blade broadly ovate to suborbicular*, *11–17 × 7–13 cm*, *base obtuse to subcordate*, *apex with short acumen to 0.8 cm long*; *midrib stout*, *terete*, *slightly elevated above*, *more so below as also lateral veins*; *lateral veins 9–11 pairs*, *slender*, *distant*, *arched*; *intercostal venation densely scalariform*, *sinuate*, *slender*; *petiole 4–6 cm long*, *geniculate.* **Inflorescences** terminal or axillary; rachis terete, to 12 cm long, singly branched, branchlets bearing to 4 flowers; bracteoles oblong, to 4 mm long, fugaceous. **Flowers:** buds to 20 × 4 mm; petals cream; *stamens c. 55*, *filament and anther glabrous*, *connectival appendage somewhat shorter than anther*, *stout*, *setose*; *ovary and stylopodium broadly ovoid*, *tapering abruptly*, *style short*, *glabrous.* **Fruits:** *calyx lobes subequal*, *short*, *incrassate*, *deltoid*, *c. 1.5 × 1.5 cm*, *appressed to nut*. **Nuts** *globose*, *very large*, *to 5 cm diameter*, *shortly mucronate.*

Vernacular name. Sarawak—*upun penyau* (Malay, preferred name).

Distribution. Endemic in Borneo. Recorded in W Sarawak from Bau, Kuching, Miri, and Samarahan districts (e.g., *S 21420*). Also occurring in Brunei (e.g., *BRUN 3060*, *BRUN 3264*, *S 1929*, and *SAN 17470*).

Ecology. Extremely local, but there frequent, in mixed dipterocarp forest on deep yellow sands on low hills, at altitudes to 300 m. Occurring in Lambir NP; elsewhere critically endangered owing to land conversion and logging.

47. **Shorea gibbosa** Brandis

(Latin, *gibbosus* = pouched; the staminal filament)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

J. Linn. Soc. Bot. 31 (1895) 99; Symington *op. cit.* (1933) 143, *op. cit.* (1943) 51; Masamune *op. cit.* 493; Keith *op. cit.* 17, 23; Browne *op. cit.* 162; Meijer & Wood *op. cit.* 71; Burgess *op. cit.* 217; Ashton *op. cit.* (1968) 83, *op. cit.* (1982) 482; Anderson *op. cit.* (1980) 122; PROSEA *op. cit.* 418; Kessler & Sidiyasa *op. cit.* 103; Coode *et al.* (eds.) *op. cit.* 78; Newman *et al. op. cit.* (1996) 146. **Type:** *Ridley 6079*, Singapore (holotype K). **Synonym:** *Hopea grisea* Brandis *op. cit.* 63.

Vast emergent tree, to 70 m tall, to 2 m diameter; bole tall, cylindrical; crown vast, cauliflower-shaped, somewhat diffuse; buttresses to 5 m tall, spreading, stout. **Bark** pale tawny, becoming cracked and peeling in thin small oblong flakes, leaving a scroll-marked surface. *Twig*, *inflorescence*, *leaf bud*, *parts of perianth exposed in bud*, *stipules*, *bracteole*, *ovary*, *nut*, *and petiole persistently shortly evenly pale buff to rufous puberulent*; *leaf venation and fruit calyx sparsely so*, *glabrescent.* **Twigs** *c.* 1 mm diameter apically, slender, terete, much-branched, pale greyish brown, striated. Leaf buds minute. **Stipules** narrowly elliptic, to 3 × 1 mm, acute, fugaceous. **Leaves** *chartaceous*, *undulate*, *pink when opening*, *drying dark tawny-brown and wrinkling*; *blade ovate*, *5–13 × 2–5 cm*, *base broadly cuneate to obtuse*, *apex with tapering acumen to 1.5 cm long*; *midrib evident but somewhat furrowed above*, *prominent below*; *lateral veins 7–9 pairs*, *slender but distinctly raised below*, *arched*; *intercostal venation subreticulate*, *slightly elevated below*; *petiole 0.8–1.2*(*–1.6*) *cm long*, *slender*. **Inflorescences** terminal or axillary; rachis terete, to 10 cm long, singly branched, branchlets bearing to 6 flowers; bracteoles oblong, obtuse, to 2 × 1 mm, fugaceous. **Flowers:** buds to 5 × 3 mm; *petals cream with pink base*; stamens 15, *connectival appendage somewhat longer than anther*, *glabrous*; *ovary ovoid*, *style columnar*, *pubescent in basal half.* **Fruits:** pedicels to 2 mm long, slender; *sepals unequal*, *3 longer lobes to 9 × 2 cm*, *tapering to 4 mm above the narrow tuberculate saccate base*, *2 shorter ones to 6 × 0.5 cm*, *otherwise similar*. **Nuts** *narrowly ellipsoid*, *acute*, *to 1.8 × 1.2 cm.*

Vernacular names. Sabah—*seraya kuning gajah* (preferred name). Sarawak—*lun gajah* (preferred name).

Distribution. SE Sumatra, Peninsular Malaysia, Singapore, and Borneo. In Sabah widespread and recorded from Beaufort, Keningau, Kinabatangan, Kota Belud, Kota Kinabalu, Labuk Sugut, Lahad Datu, Pensiangan, Ranau, Sandakan, Tambunan, Tawau, and Tenom districts (e.g., *SAN 9273*, *SAN 15452*, *SAN 16906*, *SAN 17004*, and *SAN 100174*) and in Sarawak from Bau, Belaga, Kapit, Kuching, Lundu, Marudi, Miri, and Tatau districts (e.g., *S 7971*, *S 15357*, *S 22090*, *S 43602*, and *S 43368*). Also occurring in Brunei (*BRUN 3128* and *FMS 35461*) and C, E and SE Kalimantan (e.g., *bb. 13877*, *bb. 31384*, *Endert 5256*, *Kostermans 5261*, and *Kostermans 13247*).

Ecology. Local dense populations occur in mixed dipterocarp forest on deep well-structured clay loams, particularly on low hills and undulating land over intermediate and igneous rocks but rare, scattered, on the prevailing sedimentaries, at altitudes to 1000 m. Recorded from Kubah and Mulu NPs; elsewhere endangered.

Notes. This variable species which can be confused with *S. mujongensis* which differs in its glabrous leaf and twigs, and *S. polyandra* in which the leaf dries purplish brown with darker venation below, and in which the inner bark is distinctly albeit faintly laminated.

48. **Shorea gratissima** (Wall. *ex* Kurz) Dyer

(Latin, *gratus* = pleasing; very pleasing)

(sect. **Anthoshorea**, white meranti)

Fl. Brit. Ind. 1 1874) 307; Symington *op. cit.* (1943) 36; Meijer & Wood *op. cit.* 54; Burgess *op. cit.* 159; Ashton *op. cit.* (1982) 487; PROSEA *op. cit.* 411; Newman *et al. op. cit.* (1996) 147. **Basionym:** *Hopea gratissima* Wall., Cat. (1828) 960, *nom. nud.*; *H. gratissima* Wall. *ex* Kurz, J. As. Soc. Beng. 42, 2 (1873) 61. **Type:** *Wallich s.n.*, Singapore (holotype K).

Magnificent tree, to 60 m tall, to 2 m diameter; bole straight or frequently twisted; crown large, hemispherical with a few large twisted branches; buttresses to 2 m tall, stout. **Bark** surface pale greyish fawn, shallowly vertically cracked and thinly oblong flaked; inner bark laminated orange-brown and yellow. *Exposed young parts evenly pale fulvous puberulent, glabrescent except on stipules.* **Twigs** *c.* 1.5 × 1 mm apically, at first somewhat compressed. Leaf buds ovoid, subacute, to 2 × 1 mm. **Stipules** lanceolate, acute, to 10 × 3 mm, caducous. **Leaves** *thinly coriaceous, drying pale tawny with paler venation*; *blade ovate to elliptic, 4–10 × 1.5–4.5 cm, base cuneate, margin undulate, apex acute or acuminate with slender acumen to 1 cm long*; *midrib obscure and sunken above, slender and acute below*; *lateral veins 12–14 pairs, slender, arched, hardly raised below*; *intercostal venation subscalariform, obscure*; *petiole 0.8–1.5 cm long, slender.* **Inflorescences** terminal or axillary; rachis to 10 cm long, singly (if axillary) or doubly branched, branchlets bearing to 8 flowers; bracteoles to 2 mm long, linear, fugaceous. **Flowers:** buds to 5 × 3 mm; *stamens 25, anthers oblong, tapering, connectival appendage c. 3x the length of anther, villous in the distal half*; *ovary narrowly ovoid, without stylopodium, style c. 1½x as long as ovary.* **Fruits:** pedicels *c.* 1.5 mm long; *calyx lobes unequal, 3 longer lobes lorate-spatulate, to 7 × 1.3 cm, tapering to c. 6 mm above the saccate base, 2 shorter ones to 5.5 × 0.6 cm, otherwise similar.* **Nuts** ovoid, apiculate, to 1.5 × 0.8 cm.

Vernacular name. Sabah—*melapi laut* (preferred name).

Distribution. Myanmar, Peninsular Thailand, Sumatra, Peninsular Malaysia, Singapore, and Borneo. In Borneo known in Sabah from Kudat, Lahad Datu and Tawau districts (e.g., *SAN 15453*, *SAN 16408*, *SAN 20162*, *SAN 31644*, and *SAN A 4345*). Also occurring in Kalimantan (*pers. obs.*).

Ecology. Locally abundant in mixed dipterocarp forest on dry hills near the coast, at altitudes to 500 m. Endangered.

49. **Shorea guiso** (Blanco) Blume

(from a Philippino name)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

Mus. Bot. Lugd.-Bat. 2 (1852) 343; Merrill, Sp. Blancoan. (1918) 270, PEB (1929) 203; Symington *op. cit.* (1935) 266; Masamune *op. cit.* 494; Keith *op. cit.* 34; Browne *op. cit.* 153; Meijer & Wood *op. cit.* 171; Burgess *op. cit.* 173; Ashton *op. cit.* (1968) 71, *op. cit.* (1982) 447; Anderson *op. cit.* (1980) 119; PROSEA *op. cit.* 429; Newman *et al. op. cit.* (1998) 181. **Basionym:** *Mocanera guiso* Blanco, Fl. Filip. ed. 1 (1837) 449. **Neotype** (designated here)**:** *Merrill Sp. Blancoan. 407* (= *US 904091*), the Philippines, Luzon, Bataan province, Limay (K, US). **Synonyms:** *Euphoria malaanonan* Blanco *op. cit.* (1837) 286; *Dipterocarpus guiso* (Blanco) Blanco, Fl. Filip. ed. 2 (1845) 313; *Anisoptera guiso* (Blanco) A.DC., *op. cit.* 616; *Shorea pierrei* Hance, J. Bot. 16 (1878) 302; *S. vulgaris* Pierre *ex*

Lanessan, Pl. Util. Colon. Fr. (1886) 301; *S. vidaliana* Brandis *op. cit.* 83; *Isoptera burckii* Boerl. *op. cit.* 111; *S. obtusa* Wall. var. *kohchangensis* F.Heim, Bot. Tidsskr. (1902) 263; *S. robusta* Gaertn.*f.* var. *schmidtii* F.Heim *op. cit.* (1902) 263; *S. longipetala* Foxw. *op. cit.* (1932) 174.

Large emergent tree, to 60 m tall, to 1.6 m diameter, with dense cauliflower-shaped crown; bole straight, cylindrical; buttresses to 3 m tall, long, thin, prominently concave. **Bark** greyish tawny, becoming vertically shallowly cracked and narrowly oblong flaky; *inner bark rich pink*, *finely textured*. **Sapwood** straw-yellow *merging to dark reddish brown heartwood*, moderately hard. *Young parts at first greyish buff puberulent*, *early caducous except on inflorescence*, *parts of perianth exposed in bud*, *ovary and nut*; *becoming sparsely so as parts expand except on inflorescence and nut.* **Twigs** slender, *c.* 1 mm diameter apically. Leaf buds compressed, ovate-falcate, to 5 × 3 mm. **Stipules** oblong, subacute, to 7 × 5 mm, caducous. **Leaves** *thinly coriaceous*, *drying undulate*, *purplish above*, *pale chocolate-brown below with blackish veins and midrib*; *blade oblong-lanceolate*, 5–14 × 2.5–6 cm, *base obtuse to broadly cuneate*, *apex with broad*, *prominent acumen to 1 cm long*; *midrib slender but prominent below*, *evident but somewhat furrowed above*; *lateral veins* (*11–*)*15–19 pairs*, *slender but prominent below*, *dense*; *intercostal venation densely scalariform*, *more or less obscure*; *petiole slender*, *somewhat geniculate*, *1–1.8 cm long.* **Inflorescences** slender, lax, pendent; rachis to 10 cm long, branchlets bearing to 5 flowers; bracteoles minute, linear, fugaceous. **Flowers:** buds slender, to 1 cm long; *petals bright yellow*, *red towards base within*; *stamens 20–28*, *anthers glabrous*, *connectival appendage c. ½x the length of anther*, *with 1–4*(*–8*) *long terminal bristles*; *ovary ovoid-conical*, *without stylopodium*, *style columnar*, *c. ½x as long as ovary.* **Fruits:** *calyx lobes unequal*, *3 longer lobes to 5.5 × 1 cm*, *tapering to 3 mm broad above the saccate base*, *3 shorter ones linear-lobed*, *to 3 cm long*, *similar at base.* **Nuts** ovoid, apiculate, small, to 0.8 × 0.5 cm, hidden within calyx lobes.

Vernacular name. Sabah and Sarawak—*selangan batu merah* (preferred name).

Distribution. Cochin-China, Thailand, Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Sabah locally abundant on the coastal hills in Kinabatangan, Kudat, Lahad Datu, Sandakan, Semporna, and Tawau districts (e.g., *SAN 5230*, *SAN 16409*, *SAN 29721*, *SAN 38959*, *SAN 39221*, and *SAN 62396*) and in Sarawak rare on limestone slopes in Bau, Kapit and Miri districts (e.g., *S 27265*, *S 24692*, *S 24694*, and *S 41542*). Also occurring in E Kalimantan (e.g., *Kostermans 5889*, *Kostermans 13324* and *Kostermans 13470*).

Ecology. In mixed dipterocarp forest on dry sites, at altitudes to 300 m; locally common along the east coast of Sabah, as also in the weakly seasonal tropics throughout its range. Vulnerable.

50. **Shorea havilandii** Brandis

(G.D. Haviland, 1857–1901, first Sarawak Medical Officer, plant and insect collector)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

J. Linn. Soc. Bot. 31 (1895) 82; Merrill *op. cit.* (1921) 405; Masamune *op. cit.* 494; Browne *op. cit.* 168; Ashton *op. cit.* (1964) 136, *op. cit.* (1968) 72, *op. cit.* (1982) 448; Meijer & Wood *op. cit.* 173; Burgess *op. cit.* 202; Anderson *op. cit.* (1980) 119; PROSEA *op. cit.* 430; Coode *et al.* (eds.) *op. cit.* 78; Newman *et al. op. cit.* (1998) 182. **Type:** *Haviland 2395/1899*, Borneo, Sarawak, near Kuching (holotype K; isotype L). **Synonym:** *Hopea ovalifolia* Boerl. *op. cit.* 102.

Main canopy tree, *to 40 m tall*, *to 50 cm diameter*, with narrow dense crown; bole more or less fluted and twisted; buttresses to 0.7 m tall, small, slender. **Bark** yellowish brown, becoming thinly flaky eventually cracked and oblong flaky. *Twig*, *petiole*, *midrib above*, *leaf bud*, *stipule*, *inflorescence*, *bracteoles*, *parts of perianth exposed in bud*, *ovary*, *and nut more or less persistently greyish tawny puberulent*. **Twigs** terete, slender, *c.* 1 mm diameter apically. Leaf buds ovoid, obtuse, *c.* 2 × 1.5 mm. **Stipules** oblong, subacute, *c.* 6 × 2.5 mm, fugaceous. **Leaves** *thinly coriaceous*, *drying pale chocolate-brown below*, *mauve-brown above*, *curling*; *blade ovate-elliptic*, *8–16 × 2.5–6 cm*, *base obtuse to broadly cuneate*, *apex with narrow acumen to 0.7 cm long*; *midrib slender but prominent below*, *evident but grooved above*; *lateral veins 9–12 pairs*, *dense*, *slender but prominent below*, *with small axillary pubescent domatia*; *intercostal venation slender*, *densely scalariform*; *petiole 0.8–1.2 cm long*. **Inflorescences** terminal or axillary; rachis straight, terete or slightly compressed, to 12 cm long, singly branched, branchlets bearing to 7 flowers; bracteoles elliptic, subacute, to 4 mm long, fugaceous. **Flowers:** buds to 8 × 2.5 mm; petals cream, pink at base; *stamens 30–50*, *filaments and anthers glabrous*, *connectival appendage short*, *with single terminal bristle*; *ovary broadly ovoid*, *without stylopodium*, *style c. ½x the length of ovary*. **Fruits:** *calyx lobes subequal*, *ovate*, *thin*, *narrowly acuminate*, *saccate*, *to 1 × 0.8 cm*. **Nuts** *globose*, *to 1.5 × 1 cm*, *obtuse but for 2 mm style remnant*.

Vernacular name. Sabah and Sarawak—*selangan batu pinang* (preferred name).

Distribution. Endemic in Borneo. In Sabah recorded from Kinabatangan and Tawau districts (e.g., *SAN 16451*, *SAN 19490*, *SAN 23135*, and *SAN 26589*) and in Sarawak from Bintulu, Kuching, Lawas, Lundu, Marudi, and Miri districts (e.g., *S 1517*, *S 4428*, *S 9620*, *S 27555*, and *S 46595*). Also occurring in Brunei (e.g., *BRUN 3007* and *BRUN 5562*) wherever its habitat exists.

Ecology. Locally frequent, in *kerangas* on white sand podsols, on poorly drained white and yellow sandy alluvium, also on organic soil over limestone, at altitudes to 400 m. Occurring in Bako, Lambir and Mulu NPs; elsewhere vulnerable owing to land conversion.

51. **Shorea hemsleyana** (King) King *ex* Foxw.

(W.P. Hemsley, 1843–1924, botanist at Kew)

(sect. **Mutica**, subsect. **Mutica**, *selangan batu*)

Malay. For. Rec. 10 (1932) 167, *p.p.*; Symington *op. cit.* (1933) 129; Ashton *op. cit.* (1967) 293, *op. cit.* (1982) 536. **Basionym:** *Balanocarpus hemsleyanus* King, J. As. Soc. Beng. 62, 2 (1893) 134. **Lectotype** (designated here)**:** *King's Collector* (*Kunstler*) *6670*, Peninsular Malaysia, Perak, Larut (hololectotype K). **Synonym:** *Pachychlamys hemsleyanus* (King) Ridl., *op. cit.* (1922) 234.

Notes. Two subspecies, *viz.* subsp. *hemsleyana* and subsp. *grandiflora*, are recognised. The former occurs in Peninsular Thailand, Sumatra and Peninsular Malaysia and the latter is confined to Sarawak and W Kalimantan in Borneo.

subsp. **grandiflora** (Brandis) P.S.Ashton

(Latin, *grandis* = large, *flora* = flower; large-flowered)

Gard. Bull. Sing. 22 (1967) 293, *op. cit.* (1968) 109, *op. cit.* (1982) 536; Browne *op. cit.* 147; Anderson *op. cit.* (1980) 126; PROSEA *op. cit.* 395; Newman *et al. op. cit.* (1996) 147. **Basionym:**

Shorea grandiflora Brandis *op. cit.* 93. **Type:** *Haviland 2121*, Borneo, Sarawak, near Kuching (holotype K).

Main canopy or subcanopy tree, *to 20 m tall*, *to 40 cm diameter*, with dense hemispherical crown; bole cylindrical; buttresses low, rounded. **Bark** pink and grey-mottled, becoming shallowly densely v-section fissured; inner bark yellowish brown, faintly laminated; heartwood pink. *Twig*, *inflorescence*, *leaf bud*, *parts of perianth exposed in bud*, *stipule and bracteole outside*, *petiole*, *and leaf venation below densely persistently more or less yellowish brown to fulvous scabrid-tomentose*; *fruit calyx lobes*, *ovary and nut*, *stipule and bracteole inside*, *and midrib above evenly so*. **Twigs** terete, stout, 2–4 mm diameter apically. Leaf buds lanceolate, subacute, to 6 × 3 mm. **Stipules** *lanceolate*, *subacute*, *to 16 × 5 mm*, *not at first caducous*. **Leaves** *coriaceous*, *drying pale mauve-brown above*, *rufous scabrid below*; *blade oblong*, *10–23 × 4–11 cm*; *midrib and venation prominent below*, *somewhat furrowed above*; *lateral veins 14–17 pairs*; *intercostal venation remotely scalariform*; *petiole short*, *stout*, *0.6–1.2 cm long*. **Inflorescences** axillary; rachis terete, to 4 cm long, singly branched, flowers crowded on short branchlets; bracteole elliptic, obtuse, to 3 mm. **Flowers:** *buds large*, *to 18 × 6 mm*; *petals dark red within*, *pink outside*; *stamens 15*, *connectival appendage becoming reflexed*; *ovary ovoid*, *stylopodium short*, *pubescent*, *style as long as ovary*, *glabrous*. **Fruits** subsessile; *calyx lobes subequal*, *3 longer lobes as short as ripe nut*, *lanceolate*, *acute*, *chartaceous*, *to 2.5 × 1.8 cm*, *with thickened and saccate base*, *2 shorter ones ovate*, *to 2 × 1.8 cm*, *otherwise similar*. **Nuts** *ovoid*, *to 7 × 3 cm*, *shortly apiculate*.

Distribution. Endemic in Borneo; recorded from Kapit, Kuching and Lundu districts in Sarawak (e.g., *S 584*, *S 18860*, *S 35964*, and *S 35966*) and Lower Kapuas, in W Kalimantan.

Ecology. Rare, in mixed dipterocarp forest on yellow leached sandy clay soils, and on shallow peat, at altitudes to 600 m. Recorded from Kubah NP; elsewhere endangered.

52. **Shorea hopeifolia** (F.Heim) Symington

(Latin, *Hopea*-like, *folia* = leaf)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. S. S. 7 (1933) 150, Gard. Bull. S. S. 8 (1934) 36, *op. cit.* (1943) 52; Masamune *op. cit.* 494; Browne *op. cit.* 163; Meijer & Wood *op. cit.* 73; Burgess *op. cit.* 217; Ashton *op. cit.* (1968) 84, *op. cit.* (1978) 43, *op. cit.* (1982) 482; Anderson *op. cit.* (1980) 122; PROSEA *op. cit.* 419; Coode *et al.* (eds.) *op. cit.* 78; Newman *et al. op. cit.* (1996) 148. **Basionym:** *Cotylelobium hopeifolium* F.Heim *op. cit.* (1891) 971. **Type:** *Beccari PB 2491*, Borneo, Sarawak, Matang (holotype P). **Synonyms:** *Shorea ridleyana* King *op. cit.* 115, *p.p.*; *Hopea heimiana* Brandis *op. cit.* 63, Merrill *op. cit.* (1921) 402; *H. albescens* Ridl., J. Str. Br. Roy. As. Soc. 73 (1916)142; *S. kalunti* Merr., Philip J. Sci. 26 (1925) 475; *H. hopeifolia* (F.Heim) Slooten, Bull. Jard. Bot. Buitenz. 3, 10 (1929) 396.

Vast and elegant emergent tree, to 65 m tall, to 2 m diameter, with large diffuse cauliflower-shaped crown; bole majestic, columnar; buttresses massive to 4 m tall, spreading, stout. **Bark** tawny brown, shallowly vertically cracked and thinly oblong flaky; dammar coxcombs few, small, blackish. *Vegetative parts glabrous*; *inflorescence*, *bracteole outside*, *parts of perianth exposed in bud*, *ovary*, *base of style and nut persistently pale buff woolly-puberulent*; *fruit calyx glabrescent except at base*. **Twigs** slender, much-branched, terete, minutely rugulose, *c.* 1 mm diameter apically. Leaf buds ovoid, acute, minute, *c.* 1 × 1 mm. **Stipules** lanceolate, acute, to 5 × 2 mm, fugaceous. **Leaves** *somewhat chartaceous and* *undulate*, *drying dark tawny-brown with the midrib distinctly dark red below*; *blade ovate*, *3.5–8 × 2–4 cm*, *base broadly cuneate*, *apex with prominent acumen to 1 cm long*; *midrib flat above*, *prominent below*, *usually with prominent pore-like domatia either side at base*; *lateral veins 9–11 pairs*, *with distinct shorter intermediates*, *slender*, *hardly raised below*, *arched*; *intercostal venation reticulate*, *evident*; *petiole slender*, *geniculate*, *0.8–1 cm long.* **Inflorescences** terminal or axillary; rachis terete, to 5 cm long, singly branched, branchlets bearing to 9 flowers; bracteoles elliptic, obtuse, to 2 × 2 mm. **Flowers:** buds to 5 × 2 mm; petals pale yellow; *stamens 15*, *connectival appendage slightly shorter than anther*; *ovary ovoid*, *without stylopodium*, *style columnar.* **Fruits:** pedicels to 3 mm long; *calyx lobes unequal*, *3 longer lobes to 7 × 1.5 cm*, *tapering to 4 mm above the saccate tuberculate base*, *2 shorter ones to 4 × 0.7 cm*, *otherwise similar.* **Nuts** ellipsoid, to 2.7 × 1.2 cm, shortly apiculate.

Vernacular names. Sabah—*seraya kuning jantan* (preferred name). Sarawak—*lun siput jantan* (preferred name).

Distribution. Sumatra, Peninsular Malaysia, Borneo, and the Philippines (Mindanao). In Sabah, recorded from Beaufort, Tambunan, Tawau, and Tenom districts (e.g., *SAN 15104*, *SAN 17161*, *SAN 19492*, *SAN 32051*, and *SAN A 4313*) and in Sarawak from Bintulu, Kuching, Lundu, Miri and Tatau districts (e.g., *S 9603*, *S 20285*, *S 25041*, *S 32446*, and *S 53414*). Also occurring in Brunei (*BRUN 2529* and *FMS 30383*) and C Kalimantan (e.g., *Argent et al. 9461*, *bb. 24181* and *Jarvie & Ruskandi 5771*).

Ecology. As *S. gibbosa* and often occurring with it, but less common; occasionally to 1200 m altitude. Recorded from Lambir NP; elsewhere endangered.

Notes. Easily confused with *S. multiflora* but the midrib here dries dark red below, while the tree becomes vastly taller.

53. **Shorea hypoleuca** Meijer

(Greek, *hypo*- = underneath, *leucos* = white; the leaf undersurface)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

Act. Bot. Neerl. 12 (1963) 329; Meijer & Wood *op. cit.* 174; Burgess *op. cit.* 202; Ashton *op. cit.* (1968) 72, *op. cit.* (1982) 459; Anderson *op. cit.* (1980) 119; Newman *et al. op. cit.* (1998) 183. **Lectotype** (designated here)**:** *G.H.S. Wood SAN 16048*, Borneo, Sabah, Sandakan district, Sepilok FR (hololectotype K).

Large emergent tree, to 60 m tall, to 1.8 m diameter; bole tall, cylindrical; crown hemispherical, pale from below; buttresses low, thin. **Bark** fawn-brown, irregularly flaky. *Midrib above*, *leaf bud*, *inflorescence*, *parts of perianth exposed in bud*, *ovary*, *nut*, *stipule*, *and bracteole shortly evenly persistently ochreous puberulent*; *fruit calyx glabrescent except towards base*; *mature tree twig*, *midrib above*, *petiole*, *and leaf blade below yellowish cream lepidote.* **Twigs** ribbed at first, becoming terete, 1.5–2 mm diameter apically. Leaf buds ovoid, obtuse, to 3 × 2 mm. **Stipules** oblong-ovate, to 7 × 4 mm, subacute, fugaceous. **Leaves** *coriaceous*, *drying tawny-brown above*, *pale yellow lepidote below*; *blade ovate to narrowly elliptic*, *8.5–17 × 3.5–8 cm*, *base cuneate to obtuse*, *margin more or less undulate distally*, *apex with slender acumen to 1.5 cm long*; *midrib and lateral veins evident but furrowed above*, *prominent below*; *lateral veins 11–16 pairs*, *ascending*, *with small* *glabrous axillary domatia*; *intercostal venation scalariform*, *unraised*; *petiole 1–1.6 cm long*. **Inflorescences** terminal or axillary; rachis ribbed, to 14 cm long, singly branched, branchlets bearing to 5 flowers; bracteoles small, fugaceous. **Flowers:** buds to 10 × 2 mm; *petals pale yellow*; *stamens c. 33*, *filaments and anthers glabrous*, *connectival appendage as long as anther*, *setose with the apical bristles longer*; *ovary and stylopodium pyriform*, *style short*, *glabrous*. **Fruits:** *calyx lobes unequal*, *3 longer lobes to 8.5 × 1.7 cm*, *tapering to c. 3 mm above the saccate base*, *2 shorter ones to 6 × 0.4 cm*, *similar at base*. **Nuts** ovoid, to 1.5 × 1 cm, with to 3 mm long tapering stylopodium.

Vernacular name. Sabah and Sarawak—*selangan batu kelabu* (preferred name).

Distribution. Endemic in Borneo. In Sabah recorded from Beaufort, Beluran, Kudat, Lahad Datu, Sandakan, and Tawau districts (e.g., *FMS 35636*, *KEP 80505*, *SAN 36654*, *SAN 37368*, and *SAN A 214*) and in Sarawak from Lawas and Lundu districts (e.g., *S 1751*, *S 7967*, *S 10158*, and *S 10175*).

Ecology. In mixed dipterocarp forest on well-structured clay soils over sedimentary and basic to intermediate igneous rocks, and around the base of limestone hills, at altitudes to 400 m; local but frequent where it occurs. Occurring in Sepilok FR; elsewhere vulnerable, possibly endangered, by forest conversion.

54. **Shorea iliasii** P.S.Ashton

(Ilias Paie, research assistant and sometime curator of the Kuching herbarium, avid and discriminating plant hunter)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. Sing. 22 (1967) 291, *op. cit.* (1968) 85, *op. cit.* (1982) 480; Anderson *op. cit.* (1980) 122; Newman *et al. op. cit.* (1996) 149. **Type:** *Ilias S 15102*, Borneo, Sarawak, Bintulu district, Ulu Segan FR (holotype K).

Emergent tree, to 50 m tall, to 1 m diameter; crown dense, hemispherical; bole cylindrical, tall; buttresses to 2 m tall, stout. **Bark** fawn-brown, becoming irregularly flaky. *Young parts greyish sericeous caducous except on inflorescence*, *parts of perianth exposed in bud*, *base of fruit calyx*, *ovary*, *and nut.* **Twigs** slightly compressed at first, minutely striated, *c.* 2 mm diameter apically. Leaf buds conical, subacute, *c.* 2 × 2 mm. **Stipules** not seen. **Leaves** *coriaceous*, *drying tawny-brown*, *darker above than below*; *blade oblong-ovate*, *19–25 × 9–12 cm*, *base subequal*, *obtuse but shortly decurrent with petiole*, *margin narrowly revolute*, *apex with broad*, *short acumen to 0.8 cm long*; *midrib flat or slightly raised above*, *prominent below*; *lateral veins 12–14 pairs*, *prominent below*, *obscurely furrowed above*, *arched*; *intercostal venation remotely subscalariform*; *petiole 2.2–3 cm long*, *stout*, *0.3–0.4 cm diameter*. **Inflorescences** terminal or axillary; rachis terete or compressed; bracteoles not seen. **Flowers:** buds to 4 × 2 mm; *petals cream*; *stamens 15*, *connectival appendage c. 1½x the length of anther*; *ovary narrowly ovoid*, *without stylopodium*, *style short*, *glabrous*. **Fruits:** *calyx lobes unequal*, *3 longer lobes to 8 × 2.2 cm*, *tapering to c. 4 mm above the tuberculate saccate base*, *2 shorter ones to 5.5 × 1.2 cm*, *otherwise similar*. **Nuts** *ovoid*, *to 1 × 0.8 cm*, *acute*.

Vernacular name. Sarawak—*lun siput daun besar* (preferred name).

Distribution. Endemic in Borneo. Known in Sarawak from Belaga, Bintulu, Kapit, and Lubok Antu districts (e.g., *S 14455*, *S 22041*, *S 29604*, *S 33551*, and *S 43608*) and from Ulu Barito in C Kalimantan.

Ecology. Locally frequent in mixed dipterocarp forest on yellow sandy clay soils on sedimentary rocks, on undulating land and hillsides, at altitudes to 400 m. Vulnerable owing to land conversion.

55. **Shorea inaequilateralis** Symington

(Latin, *inaequalateralis* = unequal-sided; the leaf base)

(sect. **Brachypterae**, red selangan, red meranti)

Gard. Bull. S. S. 8 (1935) 281; Masamune *op. cit.* 494; Browne *op. cit.* 153; Anderson *op. cit.* (1963) 158, *op. cit.* (1980) 126; Ashton *op. cit.* (1964) 191, *op. cit.* (1968) 109, *op. cit.* (1982) 505; PROSEA *op. cit.* 395; Coode *et al.* (eds.) *op. cit.* 78; Newman *et al*. *op. cit.* (1996) 505. **Lectotype** (designated here)**:** *Zainal FMS 30351*, Borneo, Brunei, Kuala Belait (hololectotype KEP).

Noble emergent tree, to 45 m tall, to 1.2 m diameter, with large crown and pendent branches; bole often somewhat sinuate; buttresses to 2 m tall, stout, spreading. **Bark** becoming deeply densely v-section fissured and narrowly oblong flaky, reddish brown and grey-mottled; inner bark deep reddish brown, fibrous; *heartwood hard, deep reddish brown. Young parts densely tawny pubescent, persistent on young twigs*; *leaf bud*, *outside of stipule*, *inflorescence*, *bracteole*, *parts of perianth exposed in bud*, *ovary*, *nut*, *petiole*, *and midrib above sparsely shortly so*; *appearing glabrescent on inside of stipule*, *leaf blade on both surfaces*, *and venation below.* **Twigs** *c. 2.5 × 1.5 mm apically*, *compressed at first*, *becoming terete*, *ribbed below the petiole insertion*; *stipule scars falcate*, *to 1.5 mm long.* Leaf buds ovoid, acute, somewhat compressed, 3–6 × 1.5–1.5 mm. **Stipules** *not at first caducous*, *narrowly hastate*, *acute*, *to 20 × 5 mm*. **Leaves** *chartaceous*, *drying tawny-brown*; *blade ovate*, *9–14 × 4.5–7.5 cm*, *base strongly unequal*, *subcordate*, *apex with prominent caudate acumen to 2 cm long*; *midrib evident*, *flat above*, *slender*, *terete but prominent below*; *lateral veins 11–13 pairs*, *slender*, *raised below*, *arched*; *intercostal venation scalariform*, *well-spaced*; *petiole stout*, *0.5–0.8 cm long.* **Inflorescences** terminal or axillary; rachis terete, pendent, to 7 cm long, branchlets bearing to 4 flowers; bracteoles narrowly deltoid, to 10 × 3 mm. **Flowers:** buds to 12 × 3 mm; *petals red*; *stamens 15*, *connectival appendage c. 3x as long as anther*; *ovary ovoid*, *without distinct stylopodium*, *style c. 2x as long as ovary.* **Fruits:** *calyx lobes unequal*, *3 longer lobes narrow*, *to 14 × 1.2 cm*, *tapering to c. 5 mm above the saccate base*, *2 shorter ones to 12 × 0.9 cm*, *similar at base.* **Nuts** *ovoid*, *to 1.8 × 1.4 cm*, *with to 6 mm slender filiform style remnant.*

Vernacular name. Sarawak—*semayur* (preferred name).

Distribution. Endemic in NW Borneo. Known in Sarawak from Marudi and Sibu districts (e.g., *KEP 79319*, *S 1263* and *S 11244*) and in Brunei from Belait district (e.g., *BRUN 990*, *FMS 30499*, *FMS 35705*, and *S 2229*).

Ecology. Very local, but there semi-gregarious, on the banks of peat swamp streams into the mixed peat swamp forest. Critically endangered.

56. **Shorea inappendiculata** Burck

(Latin, *inappendiculatus* = lacking an appendix; the short connectival appendage of the stamen)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

Ann. Jard. Bot. Buitenz. 6 (1887) 206; Merrill *op. cit.* (1921) 405; Masamune *op. cit.* 494; Browne *op. cit.* 171; Meijer & Wood *op. cit.* 175; Burgess *op. cit.* 211; Ashton *op. cit.* (1968) 73, *op. cit.* (1982) 455; Anderson *op. cit.* (1980) 120; PROSEA *op. cit.* 430; Coode *et al.* (eds.) *op. cit.* 455; Newman *et al. op. cit.* (1996) 455. **Type:** *Beccari PB 3009*, Borneo, Sarawak, Matang (holotype BO).

Large emergent tree, to 60 m tall, to 1.5 m diameter; crown large, hemispherical; bole tall, cylindrical; buttresses to 3 m tall, thin, spreading. **Bark** greyish fawn, thinly irregularly flaky. *Twigs*, *leaf buds*, *stipules*, *inflorescence*, *parts of perianth exposed in bud*, *and bracteole densely persistently rufous scabrid-pubescent*; *leaf venation below sparsely so* (*more dense on young trees*), *ovary and nut evenly so*; *blade below more or less densely silvery lepidote*. **Twigs** 2–4 mm diameter apically, prominently ribbed and somewhat compressed at first, blackish with pale horizontal stipule scars. Leaf buds ovoid, conical, to 6 × 4 mm. **Stipules** broadly lanceolate, to 10 × 4 mm. **Leaves** *coriaceous*, *often billowed between lateral veins*, *drying purplish brown above*, *more or less grey to silvery lepidote below with black venation*; *blade oblong-elliptic*, (*7–*)*10–16* × (*2–*)*3–8 cm*, *base more or less unequal*, *obtuse to cordate*, *apex shortly acuminate to obtuse*; *midrib and lateral veins prominent below*, *evident but furrowed above*; *lateral veins 13–24 pairs*; *intercostal venation densely scalariform*, *slightly elevated below*; *petiole stout*, *1.5–3 cm long*. **Inflorescences** axillary; rachis ribbed when dry, to 10 cm long, singly branched, branchlet bearing to 7 flowers; bracteoles elliptic, obtuse, to 3 × 2 mm, fugaceous. **Flowers:** buds to 7 × 3 mm; *stamens 28–34*, *filaments and anthers setose distally*, *connectival appendage as long as or longer than outer anther*, *with a few terminal bristles*; *ovary and stylopodium ovoid*, *style short*. **Fruits:** pedicels to 4 mm long, broadening into receptacle; *calyx lobes unequal*, *3 longer lobes to 13* × *3 cm*, *tapering to c. 8 mm above the saccate base*, *2 shorter ones lorate-lobed*, *to 10* × *0.9 cm*, *similar at base*. **Nuts** *ovoid*, *to 3.3* × *1.6 cm*, *prominently apiculate*.

Distribution. N Sumatra, Peninsular Malaysia (NW Johor) and Borneo. In Sabah known from Kinabatangan and Tawau districts (e.g., *SAN 16454*, *SAN 17833* and *SAN 23270*) and in Sarawak from Bintulu, Kapit, Lundu, Miri, Samarahan, and Tatau districts (e.g., *S 294*, *S 10060*, *S 15527*, *S 15885*, and *S 41128*). Also occurring in Brunei (e.g., *BRUN 3080*) and E Kalimantan.

Ecology. Scattered in mixed dipterocarp forest on well-structured clay soils, mostly in the coastal hills, at altitudes to 400 m; apparently generally rare, as single individuals with little regeneration. Recorded from Kubah and Lambir NPs; elsewhere endangered.

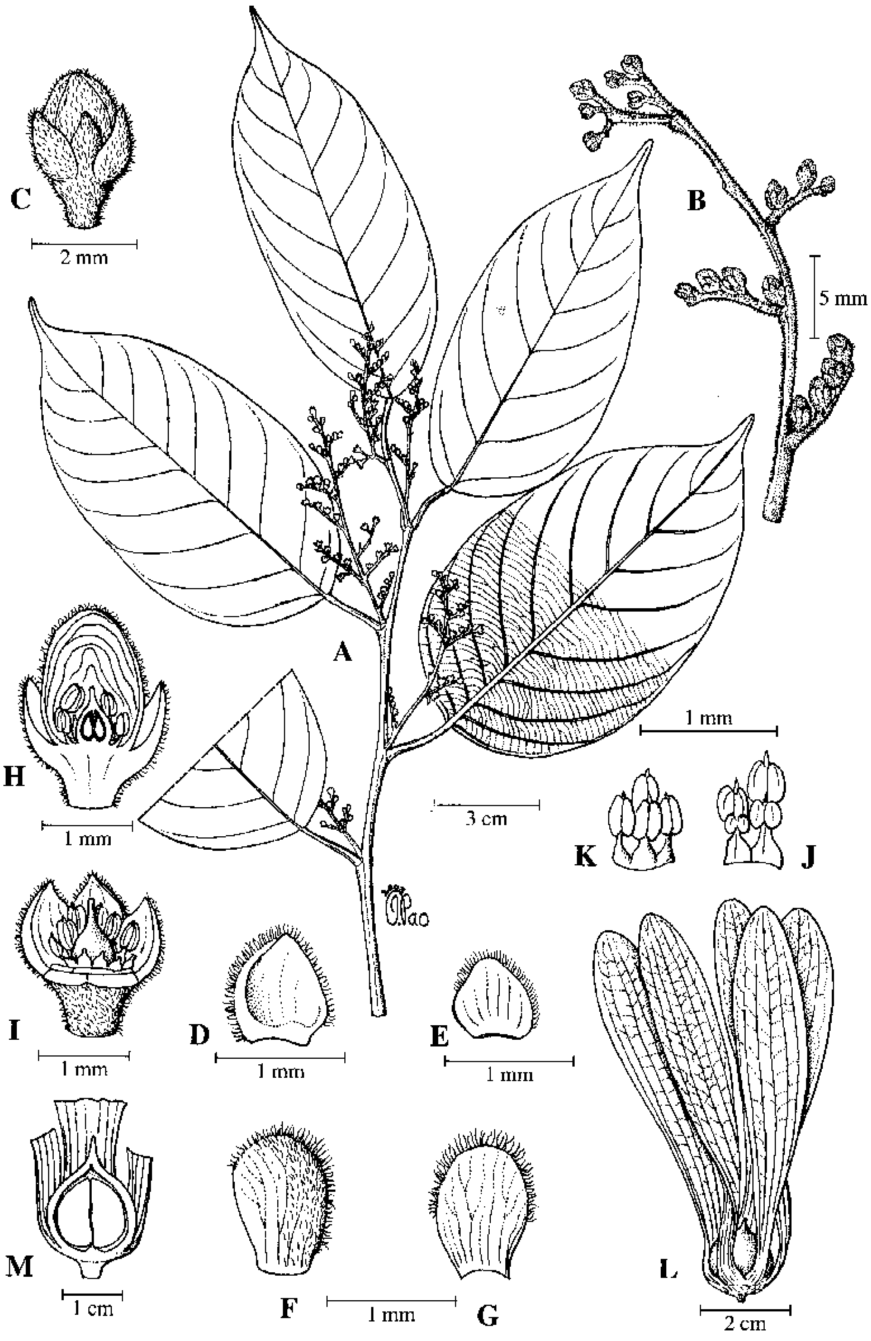

Fig. 24. *Shorea isoptera*. A, flowering leafy twig; B, part of inflorescence; C, flower bud; D, adaxial view of outer sepal; E, adaxial view of inner sepal; F, abaxial view of petal; G, adaxial view of petal; H, longitudinal section of flower bud; I, flower bud with two sepals, petals and stamens removed; J, adaxial view of stamens; K, abaxial view of stamens; L, fruit; M, longitudinal section of fruit. (A–K from *S 7978*, L–M from *SAN 39018*.)

57. **Shorea induplicata** Slooten

(Latin, *induplicatus* = sharply turned in; the leaf margins)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Reinwardtia 3 (1956) 327; Ashton *op. cit.* (1968) 85, *op. cit.* (1982) 476; Anderson *op. cit.* (1980) 122; Newman *et al*. *op. cit.* (1996) 151. **Type:** *Knight SA 582*, Borneo, Sarawak, Kuching district, Sampadi FR (holotype KEP).

Canopy or low emergent tree, to 40 m tall, to 60 cm diameter; bole frequently misshapen; crown dense, small, hemispherical, conspicuously cream-coloured in new leaf; buttresses low but continuing up bole as ribs to 3 m tall. **Bark** grey and rust-mottled, becoming thinly irregularly flaky. *Young parts pale rufous scabrid-pubescent*, *turning dark greyish brown and persisting on twig*, *leaf bud*, *stipules*, *petiole*, *and venation below*; *leaf below at first cream-puberulent*, *turning pale grey.* **Twigs** terete, becoming verruculose, *c*. 2 mm diameter apically. Leaf buds ellipsoid, obtuse, to 3 × 2 mm. **Stipules** *linear*, *not at first caducous*, *to 5 × 2 mm*. **Leaves** *coriaceous*, *drying pale greyish green above*, *pale grey below*; *blade lanceolate*, *8–17 × 2–5 cm*, *base subequal*, *cordate*, *margin prominently narrowly revolute*, *apex with slender acumen to 2 cm long*; *midrib evident but shallowly furrowed above*, *prominent below*; *lateral veins 12–16 pairs*, *prominent below*; *intercostal venation laxly subscalariform*; *petiole rather short*, *0.6–1.3 cm long*. **Inflorescences** and **flowers** unknown. **Fruits:** pedicels to 2 mm long; *calyx glabrescent*, *lobes subequal*, *ovate*, *acute*, *incrassate*, *the apices becoming patent*, *to 0.8 × 0.6 cm*. **Nuts** *broadly ellipsoid to obovoid*, *to 2.5 × 2 cm*, *subacute*.

Vernacular name. Sarawak—*lun putih* (preferred name).

Distribution. Endemic in the extreme NW Borneo. Known in Sarawak from Sampadi FR, Kuching district (e.g., *S 12611*, *S 18858* and *SFN 10399*) and in W Kalimantan from Sanggau district (e.g., *bb. 17608*).

Ecology. Rare, in the mixed dipterocarp forest-*kerangas* ecotone, on leached pale yellow and grey sandy soils, at altitude below 200 m. Critically endangered, perhaps extinct.

58. **Shorea isoptera** P.S.Ashton Fig. 24.

(Greek, *iso-* = same, *pteron* = *wing*; the subequal fruit calyx lobes)

(sect. **Neohopea**, *selangan batu*)

Gard. Bull. Sing. 19 (1962) 293, *op. cit.* (1964) 137, *op. cit.* (1968) 73, *op. cit.* (1982) 468; Meijer & Wood *op. cit.* 189; Burgess *op. cit.* 203; Anderson *op. cit.* (1980) 120; Coode *et al.* (eds.) *op. cit.* 78; Newman *et al. op. cit.* (1998) 185. **Type:** *Ashton BRUN 3018*, Borneo, Brunei, Temburong, Bt. Patoi (holotype K; isotype L).

Emergent tree, to 60 m tall, to 1.5 m diameter, with stout cylindrical bole; crown dense, hemispherical; buttresses stout, low. **Bark** greyish tawny, becoming irregularly rather thinly flaky; inner bark thin, pale pinkish brown, even-textured. **Sapwood** straw yellow, hard; heartwood dark brown; dammar exudations greyish white. *All vegetative parts glabrous*; *inflorescence*, *bracteole*, *parts of perianth exposed in bud*, *apex of ovary*, *and nut persistently greyish puberulent.* **Twigs** smooth, sparsely branched, slender, *c*. 1.5 mm diameter apically. Leaf buds globose, small, *c.* 1.5 mm diameter. **Stipules** caducous, not seen. **Leaves** *thinly coriaceous*, *satiny*, *drying tawny-grey*; *blade ovate*, *9–16 × 6–8 cm*, *base broadly cuneate to obtuse*, *decurrent to 2 mm down petiole* (*peltate in juveniles*), *margin undulate*, *apex with slender acumen to 1.5 cm long*; *midrib terete*, *elevated below*, *flat above*; *lateral veins 9–11 pairs*, *sunken above*, *raised below*, *slender*, *arched*, *sometimes with a few minute pore-like axillary domatia*; *intercostal venation sinuate*, *scalariform*, *very slender*, *unraised*; *petiole slender*, *1.3–2 cm long*. **Inflorescences** terminal or to 3-axillary; rachis slender, terete or somewhat compressed, lax, regularly doubly branched, branchlets bearing to 6 close flowers; bracteoles linear, to 1 mm long, fugaceous. **Flowers:** *buds globose*, *to 1.5 mm long*; *sepals subequal*, *imbricate*, *acute*, *3 outer lobes ovate*, *2 inner ones deltoid*; *petals oblong*, *obtuse*, *contorted*, *falling separately*; *stamens 15*, *filaments broad*, *short*, *glabrous*, *anthers broadly oblong*, *outer anther locules slightly larger than that of the inner ones*, *connectival appendage short*, *stout*, *glabrous*; *ovary and stylopodium ovoid-conical*, *style short glabrous*. **Fruits:** *calyx lobes subequal*, *lobes to 5.5 × 1.5 cm*, *tapering to 5 mm broad above the short saccate base*, *becoming rotate when ripe*, *barely twisted*. **Nuts** *ovoid*, *to 0.9 × 1 cm*, *with to 4 mm tapering style remnant*, *on a broad shallow receptacle*.

Vernacular names. Sabah—*selangan batu gelombang* (preferred name). Sarawak—*selangan batu bulu ayam* (preferred name).

Distribution. Endemic in Borneo, widespread but local. In Sabah, known from Beaufort, Kota Belud, Sandakan, Sipitang, and Tenom districts (e.g., *SAN 15111*, *SAN 16603*, *SAN 36909*, *SAN 39018*, and *SAN A 4319*) and in Sarawak from Bau, Kuching, Lundu, and Marudi districts (e.g., *S 7978*, *S 10169*, *S 22828*, *S 22829*, and *S 32659*). Also occurring in Brunei (*BRUN 3343*, *BRUN 5676* and *KEP 80132*) and E Kalimantan.

Ecology. Very local in mixed dipterocarp forest on clay-rich soils over shale and intemediate igneous rocks, at altitudes to 500 m; rather rare. Occurring in G. Gading NP; elsewhere endangered as its habitat is choice for oil palm plantation.

59. **Shorea johorensis** Foxw.

(of Johor, Peninsular Malaysia)

(sect. **Brachypterae**, red meranti)

Malay. For. Rec. 10 (1932) 236; Symington *op. cit.* (1943) 72; Ashton *op. cit.* (1967) 294, *op. cit.* (1982) 513; PROSEA *op. cit.* 395; Kessler & Sidiyasa *op. cit.* 103; Coode *et al.* (eds.) *op. cit.* 78; Newman *et al*. *op. cit.* (1996) 152. **Type:** *Bain KEP 5992*, Peninsular Malaysia, Johor, G. Panti (holotype KEP). **Synonym:** *Shorea leptoclados* Symington *op. cit.* (1939) 376, *op. cit.* (1943) 77, Keith *op. cit.* 12, Browne *op. cit.* 140, Ashton *op. cit.* (1964) 195, *op. cit.* (1968) 110, Meijer & Wood *op. cit.* 112, Burgess *op. cit.* 154, 184, Anderson *op. cit.* (1980) 126.

Large emergent tree, to 50 m tall, to 1.6 m diameter; crown large, hemispherical; bole tall, straight, symmetrical; buttresses to 3 m tall, stout, prominent. **Bark** tawny-grey to fawn, overall appearing smooth, shallowly densely cracked and thinly oblong flaky. *Twig*, *inflorescence*, *leaf bud*, *parts of perianth exposed in bud*, *stipules*, *bracteole*, *ovary*, *nut*, *petiole*, *venation below*, *and midrib above shortly evenly persistently greyish buff pubescent*;

young leaf caducously so. **Twigs** 2–3 mm diameter apically, somewhat ribbed and compressed at first, much branched; stipule scars to 2 mm long, pale, falcate, descending. Leaf buds ovoid, compressed, 6–8 × 2–3 mm. **Stipules** lanceolate, to 35 × 7 mm, caducous. **Leaves** *chartaceous*, *drying tawny-grey below*; *blade ovate*, *9–14 × 4.5–7.5 cm*, *base obtuse to subcordate*, *apex with slender and tapering acumen to 0.7 cm long*; *midrib evident*, *more or less flat*, *above*, *slender but prominent below*; *lateral veins 10–12 pairs*, *slender but prominent below*, *arched towards their ends*, *the basal 3–6 pairs usually with paired scale-like domatia*; *intercostal venation densely scalariform*, *very slender*; *petiole 1.5–2 cm long.* **Inflorescences** terminal or axillary; rachis terete or somewhat compressed, slender, to 15 cm long, branchlets long, bearing to 18 flowers; bracteoles narrowly ovate, obtuse, to 7 mm long, caducous. **Flowers:** buds to 8 × 3 mm; petals pale yellow; stamens 15, connectival appendage *c*. 3x as long as anther; ovary globose, stylopodium indistinct, style 2x as long as ovary, filiform. **Fruits:** *calyx lobes unequal*, *3 longer lobes to 12 × 2.3 cm*, *tapering to c. 6 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 6.5 × 0.6 cm*, *similar at base*. **Nuts** broadly ovoid, to 2 × 1.4 cm, shortly apiculate.

Vernacular names. Sabah—*seraya majau* (Malay, preferred name). Sarawak—*meranti majau* (Malay, preferred name).

Distribution. E Sumatra, SE Peninsular Malaysia and Borneo. In Sabah recorded from Beaufort, Beluran, Kinabatangan, Lahad Datu, Sandakan, Sipitang, and Tawau districts (e.g., *SAN 16620*, *SAN 17233*, *SAN 17952*, *SAN 93829*, and *SAN A 512*) and in Sarawak from Kapit, Lawas, Limbang, Marudi, and Miri districts (e.g., *S 1527*, *S 1802* and *S 29616*). Also occurring in Brunei (e.g., *BRUN 355*, *FMS 30533* and *S 1951*) and E and C Kalimantan (e.g., *Sidiyasa 1121*).

Ecology. Formerly one of the commonest light red meranti species in the eastern part of its Borneo range, uncommon to the west; in mixed dipterocarp forest on moist clay and silty soils, especially on low hills and floodplains; occasionally at altitude to 800 m. Occurring in Lambir and Mulu NPs; elsewhere its natural habitat is greatly reduced by forest conversion; vulnerable.

Notes. The dull leaden dry leaf with several pairs of small pale scale-like domatia in the axils of the first few pairs of lateral veins distinguishes this species from *S. palembanica* and *S. pauciflora.*

60. **Shorea kudatensis** Wood *ex* Meijer

(of Kudat, Sabah)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Act. Bot. Neerl. 12 (1963) 346; Meijer & Wood *op. cit.* 74; Burgess *op. cit.* 217; Ashton *op. cit.* (1982) 483; Newman *et al. op. cit.* (1996) 155. **Lectotype** (designated here)**:** *G.H.S Wood SAN 15363*, Borneo, Sabah, Kudat district, Tamalang FR (hololectotype K).

Low emergent tree, to 45 m tall, to 1.9 m diameter; buttresses low, rounded. **Bark** deeply cracked, flaky. *Inflorescence*, *parts of petals exposed in bud*, *ovary*, *and nut persistently cream puberulent*; *sepals becoming sparsely so in fruit*; *twig caducously so.* **Twigs** *c*. 3 mm diameter apically, terete, more or less rugulose, stout. Leaf buds small, ovoid, obtuse. **Stipules** fugaceous. **Leaves** *coriaceous*, *lustrous above*, *drying greyish green*; *blade ovate*, *8–15 × 5–9 cm, base broadly cuneate to obtuse, subequal, shortly decurrent, apex shortly broadly acuminate; midrib stout, distinctly elevated on both surfaces; lateral veins 7–9 pairs, slender, arched; intercostal venation subreticulate, elevated below, evident above; petiole rather stout, 1.7–2.2 cm long.* **Inflorescences** terminal or axillary; rachis to 14 cm long, doubly or more branched, many-flowered; bracteoles not seen. **Flowers:** buds *c.* 3 × 2 mm; *petals cream; stamens 15, connectival appendage short, equal in length with anther, scarious apically; ovary ovoid, without stylopodium, style short.* **Fruits** subsessile; *calyx lobes unequal, 3 longer lobes to 6 × 1 cm, tapering to 3 mm above the saccate base, 2 shorter ones to 4.3 × 0.5 cm, otherwise similar.* **Nuts** narrowly ovoid, to 2 × 0.8 cm.

Vernacular name. Sabah—*seraya kuning* (preferred name).

Distribution. Endemic in NE Sabah; known from Kota Kinabalu, Kuala Penyu, Kudat, Labuan, Papar, and Pitas districts (e.g., *SAN 5905*, *SAN 15494*, *SAN 15552*, *SAN 30903*, and *SAN 37701*).

Ecology. Locally common in mixed dipterocarp forests on dry hills near the sea. Endangered.

61. **Shorea kunstleri** King

(H.H. Kunstler, 1837–1887, King's plant collector in Perak, Peninsular Malaysia)

(sect. **Brachypterae**, red meranti)

J. As. Soc. Beng. 62, 2 (1893) 116; Browne *op. cit.* 154; Ashton *op. cit.* (1964) 192, *op. cit.* (1968) 109, *op. cit.* (1982) 519; Meijer & Wood *op. cit.* 109; Burgess *op. cit.* 173; Anderson *op. cit.* (1980) 126; PROSEA *op. cit.* 430; Coode *et al.* (eds.) *op. cit.* 78; Newman *et al. op. cit.* (1996) 155. **Lectotype** (designated here)**:** *King's Collector* (*Kunstler*) *3674*, Peninsular Malaysia, Perak, Larut (hololectotype K).

Large emergent tree, to 55 m tall, to 1.9 m diameter; crown large, cauliflower-shaped, somewhat diffuse, with a few large ascending branches; bole tall, cylindrical; buttresses to 1.5 m tall, spreading, stout. **Bark** becoming pale mauve- to grey-brown, deeply narrowly v-section fissured and flaky, with yellow dammar smears; inner bark orange brown. **Sapwood** hard; heartwood dark reddish brown. *Young parts shortly pale buff puberulent; more or less caducous on twig, petiole and leaf blade; more dense and persistent on inflorescence, leaf bud, ovary, nut, stipules and bracteole outside (sparse within).* **Twigs** *c.* 2 mm diameter apically, terete, much-branched. Leaf buds falcate, 5–7 × 2–2.5 mm. **Stipules** narrowly lanceolate, to 12 × 4 mm, fugaceous. **Leaves** *coriaceous, drying pale greyish tawny; blade broadly ovate and frequently twisted to one side, 8–12 × 4.5–7 cm, base broadly cuneate to obtuse, apex with tapering acumen to 1 cm long; midrib evident but shallowly furrowed above, broadly elevated below; lateral veins 6–8 pairs, slender, more or less raised but not prominent below, arched, with or without minute axillary pore-like domatia; intercostal venation slender, scalariform; petiole 2–3.5 cm long, geniculate.* **Inflorescences** terminal or rarely axillary; rachis slender, slightly compressed on drying, to 15 cm long, branchlets lax, bearing to 9 flowers; bracteoles elliptic, obtuse, to 5 × 3.5 mm, fugaceous. **Flowers:** buds to 9 × 3 mm; corolla pale yellow, pink at base; stamens 15, *connectival appendage more than*

2x the length of anther; *ovary and stylopodium pyriform*, *style somewhat shorter than ovary*, *glabrous*. **Fruits:** calyx glabrescent, *lobes unequal*, *3 longer lobes to 8.5 × 1.8 cm*, *tapering to c. 5 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 4 × 0.4 cm*, *similar at base*. **Nuts** ovoid, to 2 × 1.5 cm, with *c.* 3 mm long conical style remnant.

Vernacular names. Sabah—*seraya sirap* (preferred name). Sarawak—*selangan merah* (preferred name).

Distribution. N Sumatra, Peninsular Malaysia and Borneo. In Sabah recorded from Lahad Datu, Sipitang, and Tawau districts (e.g., *SAN 16822*, *SAN 21503*, *SAN 24282*, *SAN 25468*, and *SAN A 294*) and in Sarawak from Bintulu, Kuching, Lawas, Miri, and Samarahan districts (e.g., *S 11079*, *S 15775*, *S 32451*, *S 40777*, and *S 46593*). Also occurring in Brunei (e.g., *BRUN 346*, *FMS 48490* and *S 1905*) and in scattered localities throughout Kalimantan (e.g., *bb. 11080*, *bb. 19164* and *bb. 26855*).

Ecology. Locally frequent in mixed dipterocarp forest on yellow sandy and sandy clay, usually deep, soils over sandstone; on ultrabasic substrates in E Sabah; occasionally on high ridges at altitudes to 800 m. Occurring in Kubah NP and common in Lambir NP; endangered outside parks system.

62. **Shorea ladiana** P.S.Ashton Fig. 25.

(Ladi Bikas, plant collector in Brunei, 1957–1962)

(sect. **Shorea**, subsect. **Barbata**, *selangan batu*)

Gard. Bull. Sing. 19 (1962) 295, *op. cit.* (1964) 138, *op. cit.* (1968) 73, *op. cit.* (1982) 463; Anderson *op. cit.* (1980) 120; Coode *et al*. (eds.) *op. cit.* 78; Newman *et al. op. cit.* (1998) 186. **Type:** *Ghazalli S 11076*, Borneo, Sarawak, Kuching district, Semengoh FR (holotype K; isotype KEP).

Main canopy tree, to 40 m tall, to 1.5 m diameter; bole cylindrical; crown dense, hemispherical; buttresses to 1 m tall, thin. **Bark** yellowish brown, becoming irregularly oblong flaky, sometimes shaggy. *Young twig and petiole cinereous*; *leaf bud*, *parts of perianth exposed in bud*, *ovary*, *nut*, *inflorescence*, *and bracteole grey-buff pubescent*; *parts otherwise glabrous*. **Twigs** terete, much-branched, 1.5–2 mm diameter apically. Leaf buds small, conical, *c.* 1 × 0.5 mm. **Stipules** unknown. **Leaves** *coriaceous*, *shiny*; *blade ovate*, *10–14 × 4.5–7.5 cm*, *base obtuse or broadly cuneate*, *margin narrowly revolute*, *apex with tapering acumen to 1.5 cm long*; *midrib evident and raised within a shallow furrow above*, *stout*, *raised but not prominent below as also the lateral veins*; *lateral veins 5–6 pairs*, *well-spaced*, *arched*; *intercostal venation indistinct*, *densely scalariform*; *petiole 1–2.2 cm long*. **Inflorescences** terminal or axillary; rachis somewhat compressed, straight, lax, with short branchlets bearing to 9 flowers; bracteoles ovoid-deltoid, acute, to 4.5 mm long, fugaceous. **Flowers:** buds globose, to 1.5 mm diameter; petals cream; *stamens 30–35*, *anther locules shortly barbate apically*, *connectival appendage longer than anther*, *densely barbate*; *ovary and stylopodium ovoid*, *style short*, *glabrous*. **Fruits:** pedicels to 3 mm long; *calyx lobes subequal*, *shorter than ripe nut*, *broadly ovate*, *acute*, *thickened*, *saccate*, *to 0.8 × 0.8 cm*. **Nuts** *ovoid-globose*, *to 1.7 × 1.4 cm*, *sharply acute at the c. 1 mm long style remnant*.

Vernacular name. Sarawak—*selangan batu kilat* (preferred name).

Distribution. Endemic in NW Borneo; known in W Sarawak from Bintulu, Kuching and Miri districts (e.g., *S 15255*, *S 27171*, *S 29309*, and *S 32416*) and in Brunei from Belait district (e.g., *BRUN 2622* and *BRUN 5543*).

Ecology. Locally frequent in mixed dipterocarp forest on deep yellow sands, at altitudes to 300 m. Recorded from Kubah NP; elsewhere endangered.

63. **Shorea laevis** Ridl.

(Latin, *laevis* = smooth, hairless; the leafy shoots)

(sect. **Shorea**, subsect. **Barbata**, *selangan batu*)

FMP 1 (1922) 232; Browne *op. cit.* 169; Ashton *op. cit.* (1964) 139, *op. cit.* (1968) 73, *op. cit.* (1978) 38, *op. cit.* (1982) 461; Meijer & Wood *op. cit.* 178; Burgess *op. cit.* 203; Anderson *op. cit.* (1980) 120; PROSEA *op. cit.* 431; Kessler & Sidiyasa *op. cit.* 104; Coode *et al.* (eds.) *op. cit.* 78; Newman *et al. op. cit.* (1998) 187. **Lectotype** (designated here)**:** *Sahak FMS 1905*, Peninsular Malaysia, Negeri Sembilan, Kuala Pilah, Serting FR (hololectotype K). **Synonyms:** *Hopea laevifolia* Parijs *in* Fedde, Rep. 33 (1933) 244; *Shorea laevifolia* (Parijs) Endert, Tectona 28 (1935) 292; *S. rogersiana* Raizada & Smitinand, Thai For. Bull. Bot. 1 (1954) 7.

Huge emergent tree, to 70 m tall, to 2.4 m diameter; bole stout, often twisted; crown vast irregular diffuse cauliflower-shaped, pale from below; buttresses to 6 × 4 m, stout. **Bark** pale orange- to grey-brown, becoming vertically cracked and irregularly thinly flaky, with pale yellow dammar smears. *Inflorescence*, *bracteole*, *parts of perianth exposed in bud*, *ovary*, *and nut persistently pale cream puberulent*; *fruit calyx sparsely so*; *vegetative parts epilose*; *leaf undersurface*, *petiole*, *and young twig cream lepidote* (mature trees). **Twigs** slender, terete, much-branched, *c.* 1 mm diameter apically. Leaf buds narrowly ovoid, 3.5 × 1.5 mm. **Stipules** narrowly lanceolate, to 8 × 2 mm, fugaceous. **Leaves** *thinly coriaceous*, *drying greyish brown with cream undersurface and black venation* (mature trees); *blade narrowly ovate-lanceolate*, *falcate*, *6.5–10 × 2.5–4 cm*, *base subequal*, *broadly cuneate*, *apex with slender acumen to 2 cm long*; *midrib and venation hardly raised on either surface*, *midrib evident above*; *lateral veins slender*, *dense*, *11–14 pairs*; *intercostal venation densely scalariform*, *slender*; *petiole 1–1.5 cm long*, *slender*, *geniculate.* **Inflorescences** terminal or axillary; rachis slender, terete, to 12 cm long, branchlets bearing to 9 flowers; bracteoles linear, to 2 mm long, fugaceous. **Flowers:** buds globose, *c.* 2 mm diameter; petals cream; *stamens c. 50*, *filaments sparsely barbate distally*, *anther locules barbate at base and apex*, *connectival appendage small*, *barbate*; *ovary and stylopodium small*, *conical*, *style short*, *glabrous.* **Fruits:** *calyx lobes unequal*, *3 longer lobes chartaceous*, *to 6.5 × 1 cm*, *tapering to c. 4 mm above the saccate base*, *2 shorter ones to 4 × 0.5 cm*, *otherwise similar*. **Nuts** ovoid, to 1.5 × 0.9 cm, with to 4 mm long tapering style remnant.

Vernacular names. Sabah—*selangan batu kumus* (preferred name). Sarawak—*kumus* (preferred name), *mikai* (Iban).

Distribution. Peninsular Myanmar, Peninsular Thailand (Pattani), N Sumatra, Peninsular Malaysia, and Borneo. In Borneo widespread. In Sabah known from Beaufort, Keningau, Kinabatangan, Kota Merudu, Kudat, Labuk Sugut, Lahad Datu, Ranau, Sipitang, Tawau, and Tenom districts (e.g., *SAN 15207*, *SAN 17037*, *SAN 26086*, *SAN 97661*, and *SAN 99560*) and in Sarawak from Belaga, Bintulu, Kapit, Lawas, Limbang, Miri, and Sri Aman districts (e.g., *S 1433*, *S 11908*, *S 23868*, *S 32268*, and *S 69765*). Also occurring in Brunei

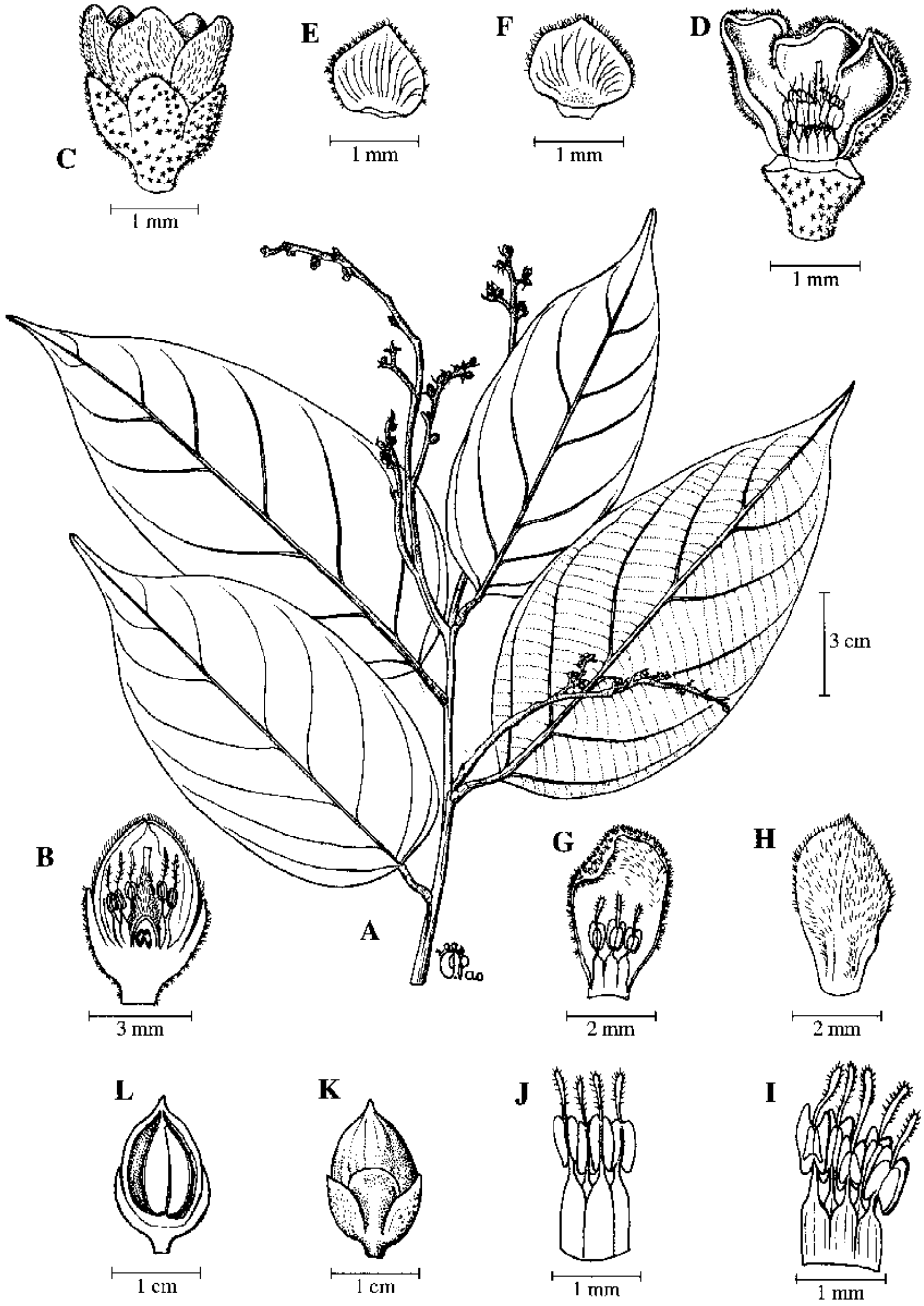

Fig. 25. *Shorea ladiana.* A, flowering leafy twig; B, longitudinal section of flower bud; C, open flower; D, open flower with sepals and two petals removed; E, adaxial view of outer sepal; F, adaxial view of inner sepal; G, adaxial view of petal with stamens; H, abaxial view of petal; I, adaxial view of stamens; J, abaxial view of stamens; K, fruit; L, longitudinal section of fruit. (A from *S 583*, B–J from *S 26229*, K–L from *S 15255*.)

(e.g., *BRUN 409* and *BRUN 3190*) and E Kalimantan (e.g., *bb. 23427*, *bb. 34270* and *bb. 34453*).

Ecology. One of the commonest emergent trees in mixed and upper dipterocarp forests along shale ridges, at 200–1000 m altitude, usually on leached skeletal clay and sandy clay soils. Occurring in Mulu NP; elsewhere vulnerable owing to logging.

64. **Shorea lamellata** Foxw.

(Latin, *lamellatus* = arranged in layers; the inner bark)

(sect. **Anthoshorea**, white meranti)

Malay. For. Rec. 10 (1932) 278; Symington *op. cit.* (1943) 39; Slooten *op. cit.* (1949) 236; Ashton *op. cit.* (1968) 94, *p.p.*, *op. cit.* (1982) 493; Anderson *op. cit.* (1980) 123, *p.p.*; PROSEA *op. cit.* 412; Kessler & Sidiyasa *op. cit.* 104; Newman *et al. op. cit.* (1996) 156. **Type:** *Arnot FMS 28082*, Peninsular Malaysia, Perak, Keledang Saiong FR (holotype KEP).

Large emergent tree, to 50 m tall, to 1.75 m diameter; bole tall, cylindrical; crown dense, hemispherical; buttresses to 3 m tall, stout. **Bark** greyish to purplish brown, becoming irregular-section fissured and coarsely flaky; inner bark laminated pale and dark yellow. *Twig*, *leaf bud*, *stipule and bracteole outside*, *inflorescence*, *and parts of calyx exposed in bud persistently tawny brown scabrid-pubescent*; *fruit calyx*, *stipule and bracteole within*, *petiole*, *and leaf venation below sparsely so*; *petals outside*, *ovary*, *and nut evenly pale brown pubescent*. **Twigs** terete, 2–3 mm diameter apically. Leaf buds ovoid-falcate, acute, to 7 × 4 mm. **Stipules** oblong-obtuse, to 20 × 6 mm. **Leaves** *thinly coriaceous*, *drying greyish*, *frequently bullate in between lateral veins*; *blade elliptic-oblong to ovate or occasionally obovate*, (*6.5–*)*10–15* × (*3.5–*)*4–8 cm*, *base obtuse to shallowly cordate*, *apex with short*, *abrupt acumen to 0.7 cm long*; *midrib slender but prominent below*, *obscure*, *sunken above*; *lateral veins 19–25 pairs*, *slender but prominent below*; *intercostal venation densely scalariform*, *evident and somewhat elevated below*; *petiole slender*, *1.6–2.2 cm long*. **Inflorescences** terminal or axillary; rachis slender, lax, to 14 cm long, singly branched, branchlets bearing to 3 flowers; bracteoles elliptic, acute, to 5 × 3 mm, tardily caducous. **Flowers:** buds ellipsoid, to 10 × 5 mm; petals white; *stamens 15*, *anthers oblong*, *twice as long as broad*, *connectival appendage 2½–3x the length of anther*, *scarious towards apex*; *ovary small*, *ovoid*, *tapering into a slender pubescent stylopodium twice its length and glabrous columnar style 3x its length*. **Fruits:** pedicels *c.* 2 mm long, fruit base obtuse; *calyx lobes unequal*, *3 longer lobes to 18* × *1.5 cm*, *tapering to c. 7 mm above the saccate base*, *2 shorter ones lorate-lobed*, *to 7* × *0.5 cm*, *similar at base*. **Nuts** ovoid, to 1.4 × 1 cm, prominently apiculate.

Vernacular name. Sarawak—*meranti lapis* (preferred name).

Distribution. Sumatra (Lingga and Singkep), Peninsular Malaysia and Borneo. Absent from Sabah. In Sarawak known from Bintulu, Kuching, Mukah, and Tatau districts (e.g., *S 902*, *S 15126*, *S 15828*, and *S 18082*). Also occurring in E and SE Kalimantan (e.g., *bb. 34264*, *Kostermans 5813*, *Kostermans 7695*, and *Kostermans 8723*).

Ecology. Rare, scattered in mixed dipterocarp forest on low hills on sandy clay soils, on sedimentary substrates and also the Arip rhyolite, at altitudes to 500 m. Recorded from Kubah NP; elsewhere endangered owing to land conversion.

Notes. Confused by Ashton (*op. cit.* (1964) 164, *op. cit.* (1968) 94), Meijer and Wood (*op. cit.* 56), Burgess (*op. cit.* 159) and Anderson (*op. cit.* (1980) 123) with *S. confusa* and *S. virescens*. The typically oblong-ovate leaf blade, terete twig and scabrid indumentum serve to distinguish this species.

65. **Shorea laxa** Slooten

(Latin, *laxus* = loose; possibly referring to the inflorescence)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Reinwardtia 3 (1956) 345; Ashton *op. cit.* (1964) 155, *op. cit.* (1968) 86, *op. cit.* (1982) 474; Meijer & Wood *op. cit.* 75; Burgess *op. cit.* 218; Anderson *op. cit.* (1980) 122; PROSEA *op. cit.* 419; Coode *et al.* (eds.) *op. cit.* 78; Newman *et al. op. cit.* (1996) 157. **Type:** *Flemmich FMS 48191*, Borneo, Brunei, Bt. Puan (holotype KEP).

Low emergent tree, to 50 m tall, to 1.6 m diameter; bole tall, cylindrical; crown dense, hemispherical; buttresses to 2.5 m tall, stout. **Bark** pale yellowish brown, becoming shallowly densely vertically cracked and thinly oblong flaky. *Inflorescence, bracteole outside, parts of perianth exposed in bud, ovary, nut, leaf bud, stipule outside, twig, petiole, and the basal half of the midrib below persistently sparsely cream-buff puberulent; calyx eventually glabrescent in fruit.* **Twigs** terete, 2 mm diameter apically. Leaf buds globose or ovoid, subacute, *c.* 3 × 2 mm. **Stipules** lanceolate, to 5 × 2 mm, fugaceous. **Leaves** *thinly coriaceous, drying warm brown, slightly shiny; blade ovate to elliptic, 7–14 × 4–9 cm, base obtuse to broadly cuneate (peltate in juveniles), margin narrowly revolute, apex with slender acumen to 1.5 cm long; midrib evident, flat above, prominent below as also the veins; lateral veins 8–10 pairs, arched and somewhat following the margin; intercostal venation scalariform, well-spaced; petiole 1.5–2.2 cm long.* **Inflorescences** terminal or axillary; rachis terete, slender, lax, to 18 cm long, branchlets bearing to 7 distichous flowers; bracteoles minute, to 1.5 mm long, fugaceous. **Flowers:** buds to 8 × 2 mm; *petals cream; stamens 15, connectival appendage 2x as long as anther, ciliate towards apex; ovary and stylopodium ovoid-conical, style short, pubescent at base.* **Fruits:** *calyx lobes subequal, broadly ovate, incrassate, saccate, tuberculate, c. 1 × 1 cm, the obtuse thin apices recurved.* **Nuts** *obovoid, acute, to 3.5 × 2.5 cm, on germination splitting to reveal brilliant red cotyledons.*

Vernacular names. Sabah—*seraya kuning keladi* (preferred name). Sarawak—*lun timbul* (preferred name).

Distribution. Endemic in the northern parts of Borneo. Known in Sabah from Labuk Sugut and Sandakan districts (e.g., *SAN 24299* and *SAN 39305*) and in Sarawak from Bintulu, Miri and Tatau districts (e.g., *S 15141*, *S 46410* and *S 46598*). Also occurring in Brunei (e.g., *BRUN 3010* and *BRUN 3061*).

Ecology. Very local on account of its local habitat, but there often common in mixed dipterocarp forest on deep yellow sandy soils of coastal hills comprised of soft neogene sandstone in Sarawak, ultrabasic substrates in Sabah, at altitudes below 400 m. Common in Lambir NP; elsewhere vulnerable.

Notes. Closely related to *S. peltata*, see there.

66. **Shorea leprosula** Miq.

(Latin, *leprosulus* = leprous; the appearance of the domatia)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

Fl. Ned. Ind., Suppl. (1861) 487; Beccari, Nelle For. Born. (1902) 570; Merrill *op. cit.* (1921) 405, *op. cit.* (1929) 203; Keith *op. cit.* 12; Masamune *op. cit.* 494; Slooten *op. cit.* (1949) 262; Browne *op. cit.* 110; Ashton *op. cit.* (1964) 193, *op. cit.* (1968) 110, *op. cit.* (1982) 540; Meijer & Wood *op. cit.* 110; Burgess *op. cit.* 154, 182; Anderson *op. cit.* (1980) 126; PROSEA *op. cit.* 396; Kessler & Sidiyasa *op. cit.* 105; Coode *et al.* (eds.) *op. cit.* 79; Newman *et al. op. cit.* (1996) 158. **Lectotype** (designated here)**:** *Teijsmann HB 1122*, Sumatra (hololectotype L). **Synonyms:** *Hopea ?maranti* Miq., *op. cit.* 489; *Shorea maranti* (Miq.) Burck *op. cit.* 217.

Large late successional tree, to 60 m tall, to 1.5 m diameter; crown pale pinkish from below, diffuse, cauliflower-shaped; bole tall, cylindrical; buttresses to 2 m tall, stout. **Bark** pale fawn-brown, deeply widely v-section fissured, the intervening ridges only becoming crumbly flaky in old trees; inner bark reddish brown. **Sapwood** light; heartwood pale reddish brown. *Twig*, *inflorescence*, *leaf bud*, *parts of flower exposed in bud*, *stipule*, *bracteole*, *petiole*, *and leaf venation below persistently densely pinkish buff-puberulent*; *blade undersurface densely pinkish brown sericeous* (mature trees only). **Twigs** terete, ridged at first, much-branched, *c.* 1.5 mm diameter apically. Leaf buds broadly ovoid, subacute, compressed, 3–5 × 2–3 mm. **Stipules** oblong to broadly hastate, obtuse, to 10 × 3.5 mm, fugaceous. **Leaves** *thinly coriaceous*, *drying pale pinkish brown above*, *pink-buff below* (*mature trees*); *blade ovate-oblong*, *8–14 × 3.5–5.5 cm*, *base obtuse or broadly acuminate*, *apex with short acumen to 0.8 cm long*; *midrib obscure*, *sunken above*, *prominent below*, *beset with lines of scale-like domatia in young trees*; *lateral veins 12–15 pairs*, *slender but prominent below*, *arched near margin*; *intercostal venation slender*, *densely scalariform*; *petiole 1–1.5 cm long.* **Inflorescences** terminal or axillary; rachis terete, lax, slender, to 14 cm long, generally singly branched, branchlets bearing to 12 flowers; bracteoles elliptic, obtuse, to 3 × 2 mm, fugaceous. **Flowers:** buds to 6 × 3 mm; petals pale yellow; stamens 15, connectival appendage short, becoming reflexed; ovary and stylopodium ovoid, glabrous, style twice their length. **Fruits:** calyx more or less glabrescent; *calyx lobes unequal*, *aliform*, *3 longer lobes to 10 × 2 cm*, *tapering to c. 5 mm above the saccate base*, *2 shorter ones to 5.5 × 0.3 cm*, *otherwise similar*. **Nuts** ovoid, to 1 × 1.3 cm, with *c.* 2 mm long tapering style remnant.

Vernacular names. Sabah—*seraya tembaga* (preferred name). Sarawak—*meranti tembaga* (preferred name; Malay).

Distribution. Extreme SE Peninsular Thailand (Pattani), Sumatra, Peninsular Malaysia, and Borneo (throughout the island in suitable habitats). In Sabah known from most districts (e.g., *SAN 15509*, *SAN 18002*, *SAN 29715*, *SAN 69199*, and *SAN 94912*) and in Sarawak from Bintulu, Kapit, Kuching, Limbang, Lundu, Marudi, Miri, and Tatau districts (e.g., *S 32115*, *S 32562*, *S 37832*, *S 43905*, and *S 75325*). Also occurring in Brunei (e.g., *BRUN 802*, *FMS 30484* and *FMS 37463*) and Kalimantan (e.g., *bb. 34268*, *Kostermans 12650* and *Meijer 2273*).

Ecology. Absent from the widespread sandy soils of Sabah and Sarawak, but frequent, locally quite common in mixed dipterocarp forest on clay soils on shales and clays, also acid and intermediate igneous rocks and periodically flooded alluvium, at altitudes to 600 m. A light demander, competitive in early to late succession and flowering more frequently than other species of sect. *Mutica*. Occurring in G. Gading, Lambir and Mulu NPs in Sarawak, and Danum Valley Conservation Area and Sepilok FR in Sabah; not vulnerable.

67. **Shorea longiflora** (Brandis) Symington

(Latin, *longus* = long, *flos* = flower)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. S. S. 9 (1938) 330; Slooten *op. cit.* (1956) 318; Browne *op. cit.* 163; Anderson *op. cit.* (1963) 158, *op. cit.* (1980) 122; Ashton *op. cit.* (1964) 156, *op. cit.* (1968) 86, *op. cit.* (1982) 473; PROSEA *op. cit.* 419; Coode *et al.* (eds.) *op. cit.* 79; Newman *et al*. *op. cit.* (1996) 160. **Basionym:** *Hopea longiflora* Brandis *op. cit.* 63. **Type:** *Haviland 2120*, Borneo, Sarawak, probably near Kuching (holotype K). **Synonym:** *Balanaocarpus longiflorus* (Brandis) Foxw. *ex* Symington *op. cit.* (1934) 29.

Understory or low main canopy tree, to 35 m tall, to 50 cm diameter; bole frequently misshapen; crown loose, oblong, with pendent branches and leaves; buttresses low, stout, occasionally with a few stilt roots. **Bark** fawn and dark grey, becoming patchily cracked and thinly irregularly flaky. *Young twig*, *leaf bud*, *inflorescence*, *parts of perianth exposed in bud*, *and stipule fulvous powdery puberulent*, *more or less caducous.* **Twigs** terete, stout, rugulose, becoming papery scaly, *c.* 2.5 mm diameter apically. Leaf buds globose or ellipsoid, slightly compressed, *c.* 3 × 2 mm. **Stipules** oblong-elliptic, to 10 × 6 mm, obtuse, concave, caducous. **Leaves** *thickly coriaceous*; *blade narrowly ovate-lanceolate*, *10–24 × 4–6 cm*, *base obtuse*, *margin prominently revolute*, *apex with slender acumen to 2 cm long*; *midrib evident but furrowed above*, *prominent below*; *lateral veins 12–15 pairs*, *prominent below*, *distant*, *arched and ascending*; *intercostal venation distantly subscalariform*; *petiole 1–1.2 cm long.* **Inflorescences** terminal or axillary; rachis terete, to 11 cm long, unbranched or singly branched, branchlets bearing few flowers; bracteoles minute, fugaceous. **Flowers:** buds to 8 × 3.5 mm; *petals brownish purple to dark yellow*; *stamens 15*, *anthers becoming reflexed at anthesis*, *connectival appendage of same length as anther*, *ciliate towards apex*; *ovary and stylopodium attenuate-ovoid*, *glabrous*, *tapering into glabrous style.* **Fruits** subsessile; *calyx lobes subequal*, *broadly deltoid to ovate*, *rather thin*, *spreading not clasping the nut*, *c. 0.7 × 0.7 cm.* **Nuts** *ellipsoid to ovoid or obovoid*, *to 4.5 × 1.7 cm*, *glabrous*, *shiny*, *with short apical style remnant.*

Vernacular name. Sarawak—*lun paya* (preferred name).

Distribution. Endemic in Borneo. Known in Sarawak from Kapit, Kuching, Marudi, Miri, Samarahan, Simunjan, and Tatau districts (e.g., *Richards 2441*, *S 6518*, *S 14400*, *S 19425*, and *S 34356*). Also occurring in Brunei (e.g., *BRUN 109*, *FMS 35658 and SAN 17535*) and C and E Kalimantan (e.g., *Suzuki K 11847*).

Ecology. Scattered, often in local patches in mixed dipterocarp forest on humic soils, often poorly drained but sometimes well-drained, on deep yellow sands; also in mixed peat swamp and *karapa* forest at 400–1000 m altitude. Occurring in Lambir NP; elsewhere vulnerable owing to its accessible habitat.

68. **Shorea longisperma** Roxb.

(Latin, *longus* = long, *spermus* = seed; the elongated nut)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Fl. Ind., ed. Carey 2 (1832) 618; Ashton *op. cit.* (1978) 43, *op. cit.* (1982) 481; PROSEA *op. cit.* 420; Coode *et al.* (eds.) *op. cit.* 79; Newman *et al. op. cit.* (1996) 161. **Type:** *Roxburgh s.n.*, Peninsular Malaysia, Penang ('Prince of Wales Is.') (holotype CAL). **Synonyms:** *Parashorea longisperma* (Roxb.) Kurz *op. cit.* 66; *Shorea resina-nigra* Foxw., *op. cit.* (1932) 205, Ashton *op. cit.* (1968) 89, Anderson *op. cit.* (1980) 123.

Huge tree, to 70 m tall, to 2.9 m diameter; bole tall, cylindrical; buttresses to 4 m tall and out, stout; crown immense, diffuse, cauliflower-shaped, pale from below. **Bark** tawny-brown, deeply cracked and thinly oblong flaky; dammar blackish oxidizing to cream, as occasional small coxcombs. *Leaf bud*, *stipule*, *inflorescence*, *bracteole*, *and parts of perianth exposed in bud persistently fulvous scabrid-puberulent*; *twig and fruit calyx caducously so*; *ovary and nut evenly buff-puberulent*; *leaf undersurface buff lepidote*. **Twigs** slender, terete, 1–2 mm diameter apically. Leaf buds ovoid, acute, to 3 × 2 mm. **Stipules** ovate to lorate, acute, to 5 × 2 mm, caducous. **Leaves** *somewhat chartaceous*, *pale mauve when opening*, *drying tawny-brown above*, *pale brownish grey below with the veins distinctly darker*; *blade elliptic to ovate*, *7–12 × 2.3–6 cm*, *base cuneate to obtuse*, *apex with slender acumen to 1.5 cm long*; *midrib evident*, *flat to shallowly furrowed above*, *prominent below*; *lateral veins 10–13 pairs*, *slender but distinctly raised below*; *intercostal venation subscalariform*; *petiole 1–1.5 cm long*. **Inflorescences** terminal or axillary; rachis terete, slender, to 7 cm long, singly branched, branchlets bearing to 4 flowers; bracteoles elliptic, to 3 × 2 mm. **Flowers:** buds to 9 × 3 mm; *petals pale yellow*; *stamens 15*, *connectival appendage c. 2x as long as anther*; *ovary and stylopodium pyriform*, *style as long as both*, *columnar*, *glabrous*. **Fruits** sessile; *calyx lobes unequal*, *3 longer lobes to 6 × 4 cm*, *tapering to c. 3 mm above the narrowly saccate tuberculate base*, *2 shorter ones linear-lobed*, *to 7 × 0.4 cm*, *similar at base*. **Nuts** *ellipsoid*, *to 2.3 × 1.2 cm*, *acute*.

Vernacular name. Sarawak—*lun meranti* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sarawak known from Belaga, Kapit, Lawas, Marudi, Miri, and Tatau districts (e.g., *S 16738*, *S 18279*, *S 19276*, and *S 69118*). Also occurring in Brunei (*BRUN 2539*) and C and E Kalimantan (e.g., *Arifin et al. Berau 727*).

Ecology. Rare, as scattered individuals in mixed dipterocarp forest on well-structured deep clay soils over shale, dacite and basalt, on low coastal hills and uplands, at altitudes to 1100 m. Vulnerable, becoming endangered owing to logging at higher altitudes.

69. **Shorea lunduensis** P.S.Ashton

(of Lundu, Sarawak)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

Gard. Bull. Sing. 22 (1967) 284, *op. cit.* (1968) 73, *op. cit.* (1982) 458; Anderson *op. cit.* (1980) 120; Newman *op. cit.* (1998) 190. **Type:** *Anderson et al. S 15396*, Borneo, Sarawak, Lundu district, G. Lundu (holotype K; isotypes KEP, L).

Large emergent tree, to 60 m tall, to 1.3 m diameter; bole straight, cylindrical; crown irregularly hemispherical, with a few large ascending branches; buttresses to 4 m tall, relatively stout. **Bark** greyish brown, irregularly flaky. *Inflorescence*, *parts of perianth exposed in bud*, *ovary*, *and nut densely buff-puberulent*, *persistent except on calyx*; *twigs and leaf bud shortly evenly fugaceous buff-pubescent*; *parts otherwise glabrous.* **Twigs** at first compressed, somewhat shiny, *c*. 3 × 2 mm apically; stipule scars pale, conspicuous, ascending, *c*. 3 mm long. Leaf buds ovoid, acute, to 5 × 3 mm. **Stipules** unknown. **Leaves** *coriaceous*, *large*, *drying yellowish brown*, *satiny above*; *blade broadly ovate to elliptic*, *14–24 × 6–15 cm*, *base broadly cuneate to subcordate*, *apex with tapering acumen to 1 cm long*; *midrib broad but hardly raised above*, *prominently so below*; *lateral veins 11–15 pairs*, *prominent below*, *ascending*; *intercostal venation densely scalariform*, *sinuate*, *evident but hardly raised*; *petiole 2–3.5 cm long*, *geniculate.* **Inflorescences** terminal or axillary; rachis subterete, to 12 cm long, branchlets bearing to 5 flowers. **Flowers:** buds to 10 × 3 mm; corolla cream; *stamens 47–52*, *filaments and anthers glabrous*, *connectival appendage exceeding the length of anther*, *densely setose*; *ovary and stylopodium pyriform*, *style glabrous*, *columnar.* **Fruits** (mature fruit unknown)**:** *calyx lobes* unequal. **Nuts** ovoid, shortly apiculate.

Distribution. Endemic in W Borneo. In Sarawak, recorded from Bau, Kuching and Lundu districts (e.g., *S 59*, *S 7984*, *S 10172*, *S 15502*, and *S 25296*) and in Kalimantan from Sambas district (e.g., *Suzuki K 9760*).

Ecology. Very local, there frequent in mixed dipterocarp forest on clay soils, on granodiorite, andesite plugs and a porphyry dike in limestone, at altitudes to 600 m. Endangered by forest conversion.

70. **Shorea macrantha** Brandis

(Greek, *makro-* = large, *anthos* = flower)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

J. Linn. Soc. Bot. 31 (1895); Merrill *op. cit.* (1921) 405; Symington *op. cit.* (1933) 131, *op. cit.* (1943) 77; Masamune *op. cit.* 495; Browne *op. cit.* 148; Anderson *op. cit.* (1963) 110, *op. cit.* (1980) 126; Ashton *op. cit.* (1968) 110, *op. cit.* (1982) 536; PROSEA *op. cit.* 397; Newman *et al. op. cit.* (1996) 162. **Type:** *Haviland 2119*, Borneo, Sarawak, Kuching (holotype K; isotype L).

Small canopy tree, to 40 m tall, to 60 cm diameter; bole moderately straight; crown with pendent branches, twigs and leaves; buttresses short, stout. **Bark** dull purplish grey, irregularly fissured; inner bark yellowish brown, pale at cambium; heartwood pale brown, hard. *Twig*, *leaf bud*, *stipule outside*, *inflorescence*, *parts of perianth exposed in bud*, *petiole*, *and venation below densely persistently yellowish brown scabrid-pubescent*; *stipule inside*, *midrib above*, *ovary*, *and nut evenly so*; *lateral veins above and fruit calyx sparsely evenly so.* **Twigs** terete, stout, 2–4 mm diameter apically; stipule scars short. Leaf buds ovoid, subacute, 6 × 3 mm. **Stipules** *lanceolate*, *ribbed*, *subacute*, *to 16 × 5 mm*, *subpersistent*. **Leaves** *coriaceous*, *drying mauve-brown above*, *rufous below with yellowish brown tomentum*; *blade bullate between veins*, *narrowly ovate*, *6–17 × 2.5–8 cm*, *base unequal*, *cordate*, *apex with slender acumen to 1.5 cm long*; *midrib*, *lateral and intercostal venation more or less obscure*, *sunken above*, *prominent below*; *lateral veins 13–17 pairs*, *arched*; *intercostal venation laxly scalariform*; *petiole very short*, *0.5–0.6 cm long.* **Inflorescences** terminal or axillary; rachis terete, to 10 cm long, singly branched, branchlets short, the flowers congested. **Flowers:** buds to 14 × 4 mm; *petals dark red within*, *paler outside*; stamens 15, connectival appendage as long as anther; ovary ovoid, *without stylopodium*, style glabrous, about twice as long as ovary. **Fruits** subsessile; *calyx lobes subequal*, *ovate*, *acute*, *saccate towards base*, *to 2.5 × 2 cm*. **Nuts** *ellipsoid*, *to 5.5 × 2.5 cm*, *acute*.

Vernacular name. Sarawak—*engkabang bungkus* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and NW Borneo. In Borneo known only from Sarawak and recorded from Kuching, Serian, Sibu, and Sri Aman districts (e.g., *S 9781*, *S 13353* and *S 35965*).

Ecology. In small populations in the inland margins of the mixed peat swamp forest, and on poorly drained podsols on terraces in *kerangas*. Endangered.

Uses. Collected as a lesser valued illipe nut, for the cocoa butter content.

71. **Shorea macrobalanos** P.S.Ashton

(Greek, *makro-* = large, *balanos* = acorn; the huge nut)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. Sing. 22 (1967) 202, *op. cit.* (1968) 86, *op. cit.* (1982) 473; Anderson *op. cit.* (1980) 122; Kessler & Sidiyasa *op. cit.* 105; Newman *et al. op. cit.* (1996) 163. **Type:** *Smythies S 13192*, Borneo, Sarawak, Lundu district, G. Berumput (holotype K; isotypes KEP, L).

Emergent tree, to 45 m tall, to 1 m diameter; crown dense, dark, hemispherical; bole tall, cylindrical; buttresses to 3 m tall, stout. **Bark** tawny-brown, irregularly flaky. *Leaf bud and stipule persistently buff-pubescent*; *flower calyx sparsely so*; *parts otherwise glabrous.* **Twigs** terete, becoming prominently verrucose, stout, *c.* 4 mm diameter apically; stipule scars obscure, ascending, *c.* 3 mm long. Leaf buds ovoid, acute, to 2 × 2 mm. **Stipules** unknown. **Leaves** *thinly coriaceous*, *drying greyish green above*, *tawny below with the veins*, *midrib and petiole darker to blackish*; *blade oblong*, *19–37 × 9–15 cm*, *base cordate*, *margin revolute*, *apex obtuse or shortly broadly acuminate*; *midrib flat above*, *prominent below*; *lateral veins 12–16 pairs*, *prominent below*; *intercostal venation slender*, *remotely subreticulate*; *petiole stout*, *1.8–3.8 cm long.* **Inflorescences** terminal or axillary; rachis terete or somewhat compressed, to 32 cm long. **Flowers:** buds large, to 9 × 3.5 mm; *stamens 10*, *connectival appendage as long as anther*; *ovary narrowly ovoid*, *tapering*, *without stylopodium*, *style glabrous*, *short.* **Fruits** sessile; *calyx lobes subequal*, *ovate*, *acute*, *subrotate*, *not appressed to the nut*, *to 0.8 × 0.8 cm*, *mounted on a to 8 mm deep receptacle*. **Nuts** *oblong*, *to 5 × 2.5 cm*, *shortly apiculate*.

Vernacular name. Sarawak—*engkabang melapi* (Iban).

Distribution. Endemic in Borneo; known in Sarawak from Kapit and Lundu districts (e.g., *S 13712*, *S 19611*, *S 34481*, and *S 37292*). Also occurring in NW and E Kalimantan (e.g., *Suzuki K 9762*).

Ecology. Locally frequent in forest on clay soils derived from shale and intermediate, and basic igneous rocks; especially on low hills and moist valleys but also occurs at altitudes to 900 m. Conservation status uncertain; likely endangered by logging.

Notes. For differences from *S. longiflora*, see there.

72. **Shorea macrophylla** (de Vriese) P.S.Ashton Plates 4B–C.

(Greek, *makro-* = large, *phullon* = leaf)

(sect. **Pachycarpae**, red meranti)

Gard. Bull. Sing. 20 (1963) 278, *op. cit.* (1964) 196, *op. cit.* (1968) 110, *op. cit.* (1982) 523; Meijer & Wood *op. cit.* 156; Anderson *op. cit.* (1980) 127; PROSEA *op. cit.* 397; Coode *et al.* (eds.) *op. cit.* 79; Newman *et al. op. cit.* (1996) 163. **Basionym:** *Hopea macrophylla* de Vriese, Minyak Tenkawang (1861) 28. **Lectotype** (designated here)**:** *de Vriese s.n.* (= *RHL Sheet No. 902146589*), 'Borneo' (hololectotype L). **Synonyms:** *Shorea gysbertsiana* Burck *op. cit.* (1886) 15, Merrill *op. cit.* (1921) 405, Browne *op. cit.* 139, Meijer & Wood *op. cit.* 108, Burgess *op. cit.* 182; *S. bakeriana* F.Heim *op. cit.* (1891) 974, Merrill *op. cit.* (1921) 404; *Pachychlamys gysbertsiana* (Burck) Ridl., *op. cit.* (1922) 233 (*sphalm. ghysbertsiana*).

Stocky low emergent or main canopy tree, to 45 m tall, to 1.5 m diameter; crown dense, oblong to hemispherical, branch endings pendent; bole usually not tall, often misshapen; buttresses to 2 m tall, stout. **Bark** greenish grey to pale brown, at first smooth, hoop-marked, becoming thinly irregularly flaky, leaving scroll-marked new surfaces; inner bark pale yellowish brown; heartwood rather light, pale brown. *Young twig*, *leaf bud*, *inflorescence*, *parts of perianth exposed in bud*, *ovary*, *nut*, *stipule*, *bracteole*, *petiole*, *leaf blade below*, *and midrib above persistently densely evenly pale brown pubescent*. **Twigs** *compressed*, *becoming smooth*, *2.5–4 × 2–3 mm apically*; *stipule scar amplexicaul*, *horizontal*, *c. 1 mm thick. Leaf buds hastate*, *narrowly obtuse*, *compressed*, *12–18 × 4–6 mm*. **Stipules** *broadly hastate*, *obtuse*, *large*, *to 50 × 13 mm*, *not at first caducous*. **Leaves** *thickly chartaceous*, *drying pale greyish tawny*; *blade elliptic-oblong*, *17–35 × 10–14 cm*, *base obtuse or subcordate*, *apex with slender acumen to 1.5 cm long*; *midrib broad*, *flat above*, *prominent below*; *lateral veins 11–20 pairs*, *prominent below*, *well-spaced*; *intercostal venation scalariform*, *well-spaced*, *distinctly elevated below*; *petiole 1.5–3 cm long*. **Inflorescences** terminal or axillary; rachis compressed, pendent, to 17 cm long, singly branched; bracteoles oblong, subacute, to 12 × 5 mm, not at first caducous. **Flowers:** buds to 8 × 5 mm; petals pale pink; stamens 15, connectival appendage *c.* 2x as long as anther, glabrous; ovary ovoid, densely pubescent in the distal half, stylopodium and style spindle-shaped, glabrous, as long as ovary. **Fruits:** calyx glabrescent; *calyx lobes unequal*, *3 longer lobes oblong*, *coriaceous*, *to 11 × 3 cm*, *tapering to 15 mm above the saccate base*, *2 shorter ones to 8 × 1.5 cm*, *similar at base*. **Nuts** *obovoid*, *to 6 × 4 cm*, *acute*, *large*.

Vernacular names. Sabah—*kawang jantung* (preferred name). Sarawak—*engkabang jantong* (Iban).

Distribution. Endemic in Borneo; widespread. In Sabah known from Beaufort, Keningau, Kinabatangan, Sandakan, Sipitang, and Tawau districts (e.g., *SAN 15073*, *SAN 15195*, *SAN 22864*, *SAN 23151*, and *SAN 38236*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lawas, Lundu, Miri, Mukah, Sarikei, and Song districts (e.g., *S 554*, *S 1461*, *S 29218*, *S 42150*, and *S 77061*). Also occurring in Brunei (e.g., *BRUN 5280*, *FMS 35515* and *Wong*

WKM 1570) and Kalimantan (e.g., *bb. 29058*, *Meijer 2218* and *Wilkie 94275*), north of the equator. Widely planted.

Ecology. Locally abundant, in mixed dipterocarp forest on river banks and flood plains, also less commonly on moist hillsides, at altitudes to 600 m. Most abundant from the Rajang hinterland westwards. Occurring in Lambir and Mulu NPs; not vulnerable.

Uses. Besides a serviceable light hardwood, the tree produces the best and most plentiful of the illipe nuts.

Notes. The indigenous form in E Sabah and NE Kalimantan differs in the fruit, with smaller nut and longer narrower calyx lobes, and the leaf which is somewhat narrower, with cuneate base. There may be hybridization with *S. pinanga.*

73. **Shorea macroptera** Dyer

(Greek, *makro-* = large, *pteron* = a wing; the long auriculate fruit calyx lobes)

(sect. **Mutica**, subsect. **Auriculatae**, red meranti)

Fl. Brit. Ind. 1 (1874) 267; King *op. cit.* 113; Ridley *op. cit.* (1922) 225; Foxworthy *op. cit.* (1932) 195; Symington *op. cit.* (1943) 78; Ashton *op. cit.* (1963) 276, *op. cit.* (1964) 197, *op. cit.* (1968) 111, *op. cit.* (1982) 532; Meijer & Wood *op. cit.* 116; Anderson *op. cit.* (1980) 127; PROSEA *op. cit.* 397; Newman *et al. op. cit.* (1996) 165. **Type:** *Maingay 1198* (= *Kew Distr. No. 208*), Peninsular Malaysia, Malacca (holotype K). **Synonyms:** *Shorea baillonii* F.Heim *op. cit.* (1891) 973; *S. sandakanensis* Symington *op. cit.* (1938) 343.

Main canopy to emergent tree, 40–50 m tall, 70–140 cm diameter; bole straight, cylindrical; crown dense, hemispherical; buttresses to 2.5 m tall. **Bark** remaing smooth at first, becoming shallowly v-section fissured, or patchily crumbly flaky; inner bark dark red to pale brown at cambium; heartwood light, pinkish brown. *Young twig*, *inflorescence*, *leaf bud*, *parts of perianth exposed in bud*, *fruit calyx outside*, *stipule and bracteole outside* (*sericeous within*), *and petiole sparsely tufted puberulent*, *glabrescent*, *or densely*, *evenly persistent pubescent*. **Twig** frequently somewhat compressed, becoming terete, *c.* 2 mm diameter apically. Leaf buds ovoid, subacute, 4–6 × 2.5–4 mm. **Stipules** oblong, subacute, to 8 × 3 mm, fugaceous. **Leaves** *coriaceous*, *somewhat shiny*, *drying distinct pale orange-brown*; *blade narrowly elliptic*, or narrowly ovate, or narrowly oblong, (*8–*)*12–19*(*–23*) × *3.7–9.5 cm*, *base narrowly cuneate or obtuse*, *apex tapering* or abruptly attenuate; *midrib obscure*, *shallowly sunken above*, *prominent below*; *lateral veins 10–15*(*–18*) *pairs*, *prominent below*, *arched*; *intercostal venation densely scalariform*, *sinuate*; *petiole 1.5–2 cm long*. **Inflorescences** terminal or axillary; rachis slightly compressed or terete, lax, *13–16 cm long*, *singly or doubly branched*, branchlets bearing to 7 distichous flowers; bracteoles elliptic, obtuse, to 3.5 × 2.5 mm. **Flowers:** buds to 5 × 3 mm; petals cream with pink base; stamens 15, connectival appendage short, becoming reflexed; ovary and stylopodium conical, style half their length, glabrous. **Fruits:** *calyx lobes unequal*, *3 longer lobes 12–14 × 2–3 cm*, *somewhat tapering to 1.2 cm wide at the incrassate concave hardly auriculate base*, *2 shorter ones lorate-lobed*, *to 6 × 0.6 cm*, *at base hardly auriculate to prominently auriculate*. **Nuts** ovoid, to 1.8 × 0.2 cm, with to 2 mm acute tapering style remnant.

Vernacular names. Sabah—*seraya melantai* (preferred name). Sarawak—*meranti melantai* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo.

Ecology. In mixed dipterocarp forest on clay soils over sedimentary and igneous rocks, and on sandy clay soils, at altitudes to 900 m. Not vulnerable.

Notes. Four subspecies, *viz.* subsp. *baillonii*, subsp. *macroptera*, subsp. *macropterifolia*, and subsp. *sandakanensis*, are recognised. Whereas subsp. *macroptera* is confined to Peninsular Thailand, Sumatra, Peninsular Malaysia, and Singapore, subsp. *baillonii*, subsp. *macropterifolia* and subsp. *sandakanensis* are endemic in Borneo.

Key to subspecies

1. Inflorescences singly or doubly branched. Twigs, petiole and inflorescences sparsely tufted-puberulent, glabrescent. Two outer fruit calyx lobes hardly auriculate at base. Leaf blade narrowly elliptic, base narrowly cuneate…………………………………..

   subsp. **baillonii** (F.Heim) P.S.Ashton

   (H.E. Baillon, 1827–1895, French botanist)

   Gard. Bull. Sing. 20 (1963) 277, *op. cit.* (1968) 111, *op. cit.* (1982) 532; Brown *op. cit.* 137; Anderson *op. cit.* (1980) 127, *p.p.*; PROSEA *op. cit.* 165; Newman *et al. op. cit.* (1996) 165. Basionym: *Shorea baillonii* F.Heim *op. cit.* (1891) 973. Type: *Beccari PB 2891*, Borneo, Sarawak, Mt. Matang (holotype P). Synonym: *Shorea macroptera auct. non* Dyer: Merrill *op. cit.* (1921) 405, Masamune *op. cit.* 495, *p.p.*

   Endemic in Borneo; recorded in Sarawak from Belaga, Bintulu, Kapit, Kuching, Marudi, Miri, Simunjan, Song, and Tatau districts (e.g., *S 1490*, *S 11090*, *S 15581*, *S 25020*, and *S 43607*). Abundant in mixed dipterocarp forest on clay and sandy clay soils over sendimentary rocks, at altitudes to 600 m. Occurring in Bako, Kubah and Lambir NPs; not vulnerable.

   Inflorescences exclusively doubly branched. Twigs, petiole and inflorescences densely persistently even-pubescent. Two outer fruit calyx lobes prominently auriculate at base. Leaf blade narrowly ovate or narrowly oblong, base obtuse……………………………2

2. Leaf blade narrowly ovate, 8–16 × 4–6 cm, apex gradually tapering; petiole to 1.5 cm long…………………………………………………………………………………….

   subsp. **macropterifolia** P.S.Ashton

   (Latin, with leaves resembling those of subsp. *macroptera*)

   Gard. Bull. Sing. 20 (1963) 227, *op. cit.* (1964) 197, *op. cit.* (1968) 111, *op. cit.* (1982) 533; Meijer & Wood *op. cit.* 116, *p.p.*; Burgess *op. cit.* 182, *p.p.*; Anderson *op. cit.* (1980) 127, *p.p.*; PROSEA *op. cit.* 397; Coode *et al.* (eds.) *op. cit.* 79; Newman *et al. op. cit.* (1996) 166. Type: *G.H.S. Wood SAN 16255*, Borneo, Sabah, Sipitang district (holotype K; isotypes KEP, SAN).

   Endemic in Borneo. Known in Sabah from Beaufort, Kota Kinabalu, Kinabatangan, Sipitang, and Tawau districts (e.g., *SAN 16453*, *SAN 16598*, *SAN 72371*, *SAN 76270*, and *SAN 97510*) and in Sarawak from Bintulu, Kapit, Lawas, Limbang, and Miri districts (e.g., *S 1514*, *S 10701*, *S 15888*, *S 22323*, and *S 66163*). Also occurring in Brunei (e.g., *BRUN 356*, *FMS 48102* and *S 2151*) and E Kalimantan (e.g., *Meijer 2555*). Much overlapping in distribution with subsp. *baillonii* but not on sandy clay soils and more frequent in the hills. Occurring in Kinabalu, Lambir and Mulu NPs; not vulnerable.

Leaf blade narrowly oblong, (9–)18–23 × (4–)6.5–9.5 cm, apex abruptly tapering; petiole to 2 cm long……………………………………………………………………………

subsp. **sandakanensis** (Symington) P.S.Ashton
(of Sandakan, Sabah)

Gard. Bull. Sing. 20 (1963) 111, *op. cit.* (1982) 532; PROSEA *op. cit.* 397; Newman *et al. op. cit.* (1996) 167. Basionym: *Shorea sandakanensis* Symington *op. cit.* (1938) 343. Type: *Agama FMS 38730*, Borneo, Sabah, Sandakan district, Kabili FR (holotype KEP). Synonym: *Shorea macroptera auct. non* Dyer: Slooten *op. cit.* (1929) 203, Masamune *op. cit. 495*, *p.p.*, Meijer & Wood *op. cit.* 116, *p.p.*, Burgess *op. cit.* 182, *p.p.*

Endemic in Borneo. Known in Sabah from Beaufort, Kinabatangan, Kota Kinabalu, Kudat, Labuk Sugut, Lahad Datu, Sandakan, and Tawau districts (e.g., *SAN 23978*, *SAN 35341*, *SAN 38380*, *SAN 63791*, and *SAN 75971*). Also occurring in Brunei (e.g., *FMS 35673*) and E Kalimantan (e.g., *Meijer 2043* and *Meijer 2560*). Occurring in Danum Valley Conservation Area and Sepilok FR; elsewhere vulnerable owing to land conversion.

74. **Shorea materialis** Ridl.

(of the Materials, *i.e.*, King's (1893) Materials for a Flora of the Malay Peninsula)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

Agr. Bull. Str. & F.M.S. 9 (1910) 183; Ashton *op. cit.* (1964) 140, *op. cit.* (1968) 74, *op. cit.* (1982) 456; Anderson *op. cit.* (1980) 120; PROSEA *op. cit.* 432; Coode *et al.* (eds.) *op. cit.* 79; Newman *et al. op. cit.* (1998) 191. **Lectotype** (designated here)**:** *Ridley 15209* (Sanger Davies), Peninsular Malaysia, Pahang, Kuala Baloh (hololectotype K). **Synonym:** *Shorea glauca non* King: Browne *op. cit.* 168, *p.p.*

Emergent tree, to 40 m tall, to 1.2 m diameter; bole straight; crown rather flat, diffuse, with a few large branches, pale from below; buttresses to 1.5 m tall, thin. **Bark** reddish to yellowish brown, cracked and irregularly oblong flaky. *Young twig*, *inflorescence*, *leaf bud*, *stipule*, *bracteole*, *leaf below*, *and petiole cream lepidote*; *parts of calyx exposed in bud*, *ovary*, *nut*, *and base of fruit calyx outside cream-buff puberulent.* **Twigs** terete, dark chocolate-brown, *c.* 1.5 mm diameter apically; stipule scars pale, short, falcate. Leaf buds linear, to 3 × 1 mm. **Stipules** linear, to 12 mm long, fugaceous. **Leaves** *thinly coriaceous*, *drying pale brown above*, *cream lepidote below with darker veins*; *blade broadly ovate*, *8–15 × 3.5–8.5 cm*, *base unequal*, *cuneate to subcordate*, *apex with slender acumen to 1.5 cm long*; *midrib evident*, *flat above*, *broad but not prominently raised below*; *lateral veins 9–12 pairs*, *slender and elevated below*; *intercostal venation slender*, *densely scalariform*, *unraised*; *petiole 1.2–2 cm long.* **Inflorescences** terminal or axillary; rachis slender, to 15 cm long, singly branched, branchlets bearing to 12 flowers; bracteoles ovate, acute, to 2 mm long. **Flowers:** buds to 10 × 4 mm; corolla cream; *stamens c. 30*, *filament and anther glabrous*, *connectival appendage short*, *setose*; *ovary and stylopodium ovoid-conical*, *style short*, *glabrous.* **Fruits:** pedicel *c.* 2 mm long; *calyx lobes unequal*, *3 longer lobes to 9 × 3 cm*, *tapering to 8 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 6 × 0.8 cm*, *similar at base*. **Nuts** broadly ovoid, to 1.2 × 1.2 cm, tapering to an acute 4 mm style remnant.

Vernacular name. Sarawak—*selangan batu pasir* (preferred name).

Distribution. E Sumatra?, East coastal Peninsular Malaysia and Borneo. In Sarawak recorded from Bintulu, Marudi and Miri districts (e.g., *S 907*, *S 8254* and *S 8661*). Also occurring in Brunei (e.g., *BRUN 513* and *FMS 30553*).

Ecology. Very local, there sometimes quite common in *kerangas* forest on white sand terraces and in mixed dipterocarp forest on leached greyish yellow sands on narrow ridges, at altitudes to 800 m. Occurring in Lambir NP; elsewhere endangered.

75. **Shorea maxwelliana** King

(Sir George Maxwell, 1871–1959, one-time Resident of Perak, Peninsular Malaysia)

(sect. **Shorea**, subsect. **Barbata**, *selangan batu*)

J. As. Soc. Beng. 62, 2 (1893) 114; Symington *op. cit.* (1933) 146, *op. cit.* (1934) 28, *op. cit.* (1938) 325, *op. cit.* (1943) 21; Masamune *op. cit.* 495; Browne *op. cit.* 169; Ashton *op. cit.* (1964) 141, *op. cit.* (1968) 74, *op. cit.* (1982) 465; Meijer & Wood *op. cit.* 182; Burgess *op. cit.* 203; Anderson *op. cit.* (1980) 120; PROSEA *op. cit.* 432; Coode *et al*. (eds.) *op. cit.* 79; Newman *et al*. *op. cit.* (1998) 193. **Lectotype** (designated here)**:** *King's Collectors 3744*, Peninsular Malaysia, Perak (hololectotype K). **Synonyms:** *Shorea utilis* King *op. cit.* 119; *S. barbata* Brandis *op. cit.* 81; *S. alba* Ridl., J. Str. Br. Roy. As. Soc. 82 (1920) 171; *Balanocarpus ovalifolius* Ridl., J. Fed. Malay States Mus. 10 (1920) 130, *p.p.*

Large emergent tree, to 50 m tall, to 1.6 m diameter; bole tall, cylindrical; crown large, diffuse, cauliflower-shaped; buttresses to 4 m tall, thin, prominent. **Bark** reddish to greyish brown, becoming shallowly densely cracked and small thin oblong flaked, eventually sometimes shaggy. *Leaf bud*, *parts of perianth exposed in bud*, *fruit calyx*, *inflorescence*, *stipule*, *bracteole*, *ovary*, *and nut evenly buff-puberulent.* **Twigs** slender, much-branched, terete, smooth, *c.* 0.7 mm diameter apically. Leaf buds globose to conical, minute, *c.* 1 mm diameter. **Stipules** linear, to 4 mm long, fugaceous. **Leaves** *thinly coraceous*, *sometimes cream lepidote below*, *more or less shiny above*, *drying pale yellowish brown*; *blade ovate-lanceolate*, *6–10 × 2.5–4 cm*, *base obtuse or broadly cuneate*, *apex caudate*, *acumen to 2 cm long*; *midrib raised below*, *evident*, *raised but shallowly furrowed above*; *lateral veins 8–10 pairs*, *slender*, *raised but not prominent below*, *with or without minute axillary domatia*; *intercostal venation very slender*, *scalariform*; *petiole 0.7–1 cm long*, *slender.* **Inflorescences** terminal or to 3-axillary; rachis terete, straight, to 5 cm long, singly branched, branchlets short bearing to 6 close flowers. **Flowers:** buds globose, to 2.5 mm diameter; petals cream; *stamens c. 30*, *filaments glabrous*, *anthers setose apically*, *connectival appendage as long as anther*, *setose apically*; *ovary and stylopodium ovoid to pyriform*, *style short glabrous.* **Fruits:** *calyx lobes unequal*, *3 longer lobes to 10 × 1.5 cm*, *tapering to 4 mm above the saccate base*, *2 shorter ones to 6 × 0.6 cm*, *otherwise similar*. **Nuts** ovoid, to 2 × 1.5 cm, tapering, apiculate.

Vernacular names. Sabah—*selangan batu asam* (preferred name). Sarawak—*kumus hitam* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah, recorded from Beaufort, Kudat, Lahad Datu, Sandakan, Sipitang, Tawau, and Tenom districts (e.g., *SAN 15221*, *SAN 16644*, *SAN 28972*, and *SAN 66156*) and in Sarawak from Bau, Belaga, Kapit, Kuching, Limbang, Lundu, Marudi, Miri, and Tatau districts (e.g., *S 1816*, *S 7995*, *S 10195*, *S 19168*, and *S 46549*). Also occurring in Brunei (e.g., *BRUN 3397* and *BRUN 5774*) and SE Kalimantan (e.g., *bb. 11212* and *bb. 27761*).

Ecology. Locally frequent in mixed dipterocarp forest and occasionally *kerangas*, on a wide range of soils and substrates including basalt, shale, porphyry dykes, granodiorite and sandstone, at altitudes to 600 m. Occurring in Bako, G. Gading, Kubah, Lambir and Mulu NPs, and Sepilok FR; not vulnerable.

76. **Shorea mecistopteryx** Ridl.

(Greek, *megisto-* = very big, *pteron* = wing; the fruit calyx lobes)

(sect. **Pachycarpae**, red meranti)

Bull. Misc. Inform. Kew (1925) 280, Slooten *op. cit.* (1929) 203; Symington *op. cit.* (1938) 348; Masamune *op. cit.* 495; Ashton *op. cit.* (1964) 198, *op. cit.* (1968) 111, *op. cit.* (1982) 525; Meijer & Wood *op. cit.* 119; Burgess *op. cit.* 154, 182; Anderson *op. cit.* (1980) 127; PROSEA *op. cit.* 397; Coode *et al.* (eds.) *op. cit.* 79; Newman *et al. op. cit.* (1996) 168. **Type:** *Taha s.n.*, Borneo, Sabah, Kinabatangan (holotype K). **Synonym:** *Shorea chrysophylla* Ridl., Bull. Misc. Inform. Kew (1926) 202.

Large emergent tree, to 50 m tall, to 1.6 m diameter; bole tall, cylindrical or sometimes sinuous; crown large, becoming irregularly hemispherical, golden from below; buttresses to 2 m tall, large, stout. **Bark** long remaining smooth, hoop-marked, greyish brown, eventually cracking and thinly flaking, leaving a scroll-marked surface; inner bark dull rust-brown to orange-brown at the cambium; heartwood pinkish brown, light. *Young twig*, *inflorescence*, *stipule and bracteole outside* (*sparsely so within*), *petiole*, *and leaf below evenly persistently golden pubescent*; *nut yellowish buff-pubescent.* **Twigs** *compressed*, *to 6 × 2.5 mm apically*; *stipule scars cuneate*, *horizontal.* Leaf buds ovoid, 5–8 × 2.5–5 mm, obtuse, compressed. **Stipules** *hastate*, *acute*, *to 25 × 7 mm*, *not immediately caducous*. **Leaves** *chartaceous*, *brittle when dry and turning rich reddish brown below*, *paler above*; *blade oblong*, *13–20*(*–30*) *× 6–10*(*–12*) *cm*, *base cordate*, *apex with broad acumen to 0.8 cm long*; *midrib evident*, *more or less flat or shallowly furrowed above*, *prominent and terete below*; *lateral veins 16–20 pairs*, *slender but prominent below*, *arched*; *intercostal venation densely scalariform*, *elevated below*; *petiole 2.5–3.5 cm long*, *stout.* **Inflorescences** terminal or axillary, rachis terete or compressed, to 12 cm long, singly branched; bracteoles oblong, subacute, *c.* 7 × 2 mm. **Flowers:** buds large, to 12 × 4 mm; *connectival appendage more than 2x the length of anther*; *ovary ovoid-conical*, *glabrous*, *stylopodium slightly longer than ovary*, *cylindrical*, *thickened distally*, *style stout.* **Fruits:** *pedicel to 6 mm long*, *stout*; *calyx lobes unequal*, *glabrescent or puberulent towards base*, *3 longer lobes to 23 × 3.3 cm*, *tapering to 1.8 cm above the saccate base*, *2 shorter ones to 15 × 1.2 cm*, *otherwise similar*. **Nuts** ovoid, to 4.2 × 2.5 cm, acute.

Vernacular names. Sabah—*kawang burung* (preferred name). Sarawak—*engkabang burung* (preferred name), *engkabang larai* (Iban), *kawang tikus* (Malay).

Distribution. Endemic in Borneo; widespread but infrequent and local. In Sabah recorded from Kinabatangan and Sandakan districts (e.g., *SAN 4975*, *SAN 4977*, *SAN 5493*, *SAN 20811*, and *SAN A 3150*) and in Sarawak from Kapit, Lundu, Marudi, and Miri districts (e.g., *S 14458*, *S 15441*, *S 29278*, and *S 49889*). Also occurring in Brunei (e.g., *BRUN 3284* and *S 1634*) and C Kalimantan (e.g., *Argent 9495*, *Newman et al. 625*, *Newman et al. 626*, and *Peters 1035*).

Ecology. Local but widespread in mixed dipterocarp forest on sandy clay soils, including on intermediate igneous rocks, at altitudes to 400 m. Recorded from G. Gading NP; elsewhere vulnerable owing to land conversion.

77. **Shorea micans** P.S.Ashton

(Latin, *micans* = gleaming; the shiny leaf)

(sect. **Shorea**, subsect. **Barbata**, *selangan batu*)

Gard. Bull. Sing. 31 (1978) 38, *op. cit.* (1982) 463; Newman *et al. op. cit.* (1998) 193. **Type:** *Meijer SAN 39312*, Borneo, NE Sabah, Karamuak, Bt. Meliau (holotype L; isotypes KEP, SAN).

Low emergent or main canopy tree. **Bark** flaky. *Inflorescence and nut densely greyish puberulent*, *fruit calyx sparsely so*; *other known parts glabrous*, *shiny*. **Twigs** terete, much-branched, slender, *c*. 1 mm diameter apically. Leaf buds minute. **Stipules** unknown. **Leaves** *thinly coriaceous*, *shiny*, *drying dark tawny-brown below*, *greyish brown above*; *blade ovate-lanceolate*, *5–10 × 1.8–4.7 cm*, *base subequal*, *broadly cuneate*, *margin narrowly subrevolute*, *apex subcaudate*, *acumen to 1.3 cm long*; *midrib slender*, *evident and raised on both surfaces*; *lateral veins 7–8 pairs*, *very slender*, *slightly elevated below*; *intercostal venation scalariform*, *obscure*; *petiole very slender*, *0.7–1.2 cm long*. **Inflorescences** terminal or subteminal-axillary; rachis slender, straight, shortly branched, to 7 cm long. **Flowers** unknown. **Fruits:** pedicel *c*. 1 mm long, slender; *calyx lobes unequal*, *3 longer lobes to 5 × 1.5 cm*, *tapering to c. 4 mm above the saccate base*, *2 shorter ones to 2.5 × 0.4 cm*, *otherwise similar*. **Nuts** ovoid, to 1.9 × 0.7 cm, prominently apiculate.

Distribution. Endemic in Borneo. Known only in Sabah from Kuala Penyu, Labuk Sugut and Sandakan districts (e.g., *SAN 24279*, *SAN 50994* and the type).

Ecology. In mixed dipterocarp forest on soils overlying ultrabasic rock, at altitudes to 500 m. Critically endangered.

78. **Shorea monticola** P.S.Ashton

(Latin: *montis* = mountain, -*cola* = -dweller; the habitat)

(sect. **Brachypterae**, red meranti)

Gard. Bull. Sing. 19 (1962) 297, *op. cit.* (1964) 200, *op. cit.* (1968) 111, *op. cit.* (1982) 519; Meijer & Wood *op. cit.* 121; Burgess *op. cit.* 166; Anderson *op. cit.* (1980) 127; Coode *et al.* (eds.) *op. cit.* 79; Newman *et al. op. cit.* (1996) 169. **Type:** *Clemens 31885*, Borneo, Sabah, Mt. Kinabalu, Penibukan (holotype K; isotype L).

Low emergent tree to 40 m tall, to 1.2 m diameter; bole cylindrical, straight; buttresses to 1.5 m tall, stout; crown densely evenly hemispherical, golden suffused from below. **Bark** pinkish to reddish brown, becoming shallowly cracked and thinly patchily oblong flaked; inner bark reddish brown; heartwood dark red, hard. *Young twig*, *leaf bud*, *petiole*, *venation*, *inflorescence*, *and parts of perianth exposed in bud at first yellowish buff-pubescent*, *persistent on leaf bud*, *corolla and inflorescence*, *sparsely persisting in calyx base into fruit*, *elsewhere caducous*. **Twigs** terete, minutely warty lenticellate, stout, *c*. 3 mm diameter apically. Leaf buds narrowly ovate, acute, falcate, 5–10 × 2–4 mm. **Stipules** unknown.

Leaves *thickly coriaceous*, *drying golden- to chocolate-brown below*, *tawny-brown above*; *blade elliptic*, *8–13 × 5–8 cm*, *base obtuse to broadly cuneate*, *apex with broad*, *short*, *acumen to 0.5 cm long*; *midrib obscure*, *sunken above*, *prominent and sharply ridged below*; *lateral veins 13–16 pairs*, *prominent below*, *arched*; *intercostal venation densely scalariform*, *slender*, *hardly elevated or obscure*; *petiole 2–2.5 cm long*, *stout.* **Inflorescences** terminal or axillary; rachis terete, to 12 cm long, branchlets bearing to 12 flowers; bracteoles unknown. **Flowers:** buds to 7 × 3 mm; connectival appendage 2–3x as long as anther; ovary and stylopodium pyriform, style as long as ovary, glabrous. **Fruits:** *calyx lobes unequal*, *3 longer lobes to 7 × 1.5 cm*, *tapering only slightly above the saccate base*, *2 shorter ones narrowly oblong*, *to 3.5 × 0.6*, *similar at base*. **Nuts** ovoid, to 1.6 × 1 cm, shortly acute.

Vernacular names. Sabah—*seraya burung* (preferred name). Sarawak—*meranti gunung* (preferred name).

Distribution. Endemic in Borneo; throughout the northern mountain chain from W Kalimantan and G. Penrissen, W Sarawak, to Kinabalu and Trus Madi Range in northern Sabah. In Sabah recorded from Keningau, Kota Belud, Papar, Ranau, Sipitang, and Tambunan districts (e.g., *SAN 16704*, *SAN 16914*, *SAN 24058*, *SAN 50206*, and *SAN A 4353*) and in Sarawak from Bintulu, Kapit, Kuching, Lawas, Miri, Sri Aman, and Tatau districts (e.g., *S 4525*, *S 8816*, *S 19169*, *S 26524*, and *S 67522*).

Ecology. Locally common in the upper limits of upper dipterocarp forest, on organic soils on various substrates including basalt, at 600–1500 m altitude. Common in Kinabalu NP, and occurring in Mulu NP; probably not vulnerable.

79. **Shorea mujongensis** P.S.Ashton

(of the Mujong, Ulu Tinjar, Rajang, Sarawak)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. Sing. 22 (1967) 292, *op. cit.* (1968) 87, *op. cit.* (1982) 484; Anderson *op. cit.* (1980) 122; Kessler & Sidiyasa *op. cit.* 106; Newman *et al. op. cit.* (1996) 170. **Type:** *Ashton S 19038*, Borneo, Sarawak, Hose Mountains, Base of Bt. Temedu (holotype K; isotypes KEP, L, SAR).

Vast tree to 70 m tall, to 1.6 m diameter; crown dense, cauliflower-shaped; bole tall, cylindrical; buttresses stout, large, to 5 m tall and wide. **Bark** fawn-brown, deeply cracked and small thin oblong-flaky; dammar in dark brown coxcombs. *Young twig*, *leaf bud*, *parts of perianth exposed in bud*, *ovary*, *and nut buff-puberulent*, *caducous other than on inflorescence*, *corolla and ovary*. **Twigs** terete, rugulose, *c*. 2 mm diameter apically. Leaf buds minute. **Stipules** unknown. **Leaves** glabrous, *chartaceous*, *drying greenish grey*; *blade ovate or elliptic*, *6–14 × 2.5–5.5 cm*, *base obtuse or cuneate*, *margin narrowly revolute*, *apex with acumen to 0.8 cm long*; *midrib evident*, *flat above*, *prominent and terete below*; *lateral veins 8–13 pairs*, *slender but prominent below*; *petiole 1–1.6 cm long.* **Inflorescences** terminal or axillary; rachis terete, to 6 cm long, singly branched. **Flowers:** buds to 6 × 4 mm; *stamens 15*, *connectival appendage as long as anther*, *glabrous*; *ovary and stylopodium pyriform*, *style short*, *glabrous.* **Fruits:** pedicel to 2 mm long; *calyx lobes unequal*, *3 longer lobes to 7 × 1.5 cm*, *tapering to 4 mm wide above the narrowly saccate tuberculate base*, *2 shorter ones to 4.5 × 0.7 cm*, *otherwise similar.* **Nuts** narrowly ovoid, to 2.2 × 0.7 cm.

Distribution. Endemic in Borneo. Recorded in Sabah from Beaufort, Sandakan and Tawau districts (e.g., *SAN 4946*, *SAN 15429* and *SAN 27425*) and in Sarawak from Kapit and Kuching districts (e.g., *S 19038*, *S 19993* and *S 29569*). Also occurring in E Kalimantan.

Ecology. Frequent, but very local in mixed dipterocarp forest, and apparently mostly on basic to weakly acid volcanic rocks, on clay soils, at altitudes to 1000 m. Endangered by land conversion.

80. **Shorea multiflora** (Burck) Symington Plate 4D.

(Latin, *multi* = many, *flos* = a flower; the many-flowered inflorescence)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. S. S. 9 (1938) 330, *op. cit.* (1943) 54; Slooten *op. cit.* 3 (1956) 320; Browne *op. cit.* 63; Ashton *op. cit.* (1964) 157, *op. cit.* (1968) 87, *op. cit.* (1982) 475; Meijer & Wood *op. cit.* 76; Burgess *op. cit.* 218; Anderson *op. cit.* (1980) 122; PROSEA *op. cit.* 420; Coode *et al.* (eds.) *op. cit.* 80; Newman *et al. op. cit.* (1996) 171. **Basionym:** *Doona multiflora* Burck *op. cit.* (1887) 234. **Type:** *Teijsmann HB 12063*, Sumatra (holotype BO). **Synonyms:** *Richetia latifolia* F.Heim *op. cit.* (1891) 976; *R. acuminata* F.Heim *op. cit.* (1891) 979; *R. oblongifolia* F.Heim *op. cit.* (1891) 979; *R. penangiana* F.Heim *op. cit.* (1891) 980; *Balanocarpus penangianus* (F.Heim) King *op. cit.* 131; *Hopea multiflora* (Burck) Brandis *op. cit.* 60; *H. multiflora* (Burck) Brandis var. *venosa* Boerl., Cat. Hort. Bog. 2 (1901) 102; *Balanocarpus latifolius* (F.Heim) Brandis *op. cit.* 112, Merrill *op. cit.* (1921) 407; *B. acuminatus* (F.Heim) Brandis *op. cit.* 115, Merrill *op. cit.* (1921) 407; *B. sibogae* Boerl., *op. cit.* 112; *B. multiflorus* (Burck) Symington *op. cit.* (1933) 153.

Low emergent or main canopy tree, to 40 m tall, to 1 m diameter; bole straight, cylindrical; crown diffusely hemispherical, with many ascending branches; buttresses short, stout. **Bark** dappled fawn, becoming densely cracked and thin oblong-flaky. *Young twig*, *petiole*, *stipule outside*, *inflorescence*, *leaf bud*, *parts of perianth exposed in bud*, *and usually ovary and nut*, *densely greyish buff-puberulent*, *persistent except on twig*, *petiole and calyx*; *ovary and nut sometimes glabrous*. **Twigs** slender, terete, smooth, much-branched, *c.* 1 mm diameter apically. Leaf buds small, ovoid, *c.* 2 × 1.5 mm. **Stipules** narrowly lanceolate, to 6 × 2 mm, fugaceous. **Leaves** thinly coriaceous, drying yellowish green to yellowish brown; blade ovate-lanceolate, 4.5–7.5 × 2–3.5 cm, base cuneate, equal or subequal, sometimes with paired basal domatia, apex caudate, acumen to 1.5 cm long; midrib narrowly shallowly sunken above, somewhat raised below; lateral veins 8–10 pairs, very slender, barely elevated below, distant; intercostal venation subreticulate; petiole slender, 0.7–1 cm long. **Inflorescences** terminal or axillary; rachis terete, lax, to 16 cm, branchlets short, bearing to 9 flowers; bracteoles minute, fugaceous. **Flowers:** *buds small*, *to 2.5 mm long*; *petals pale yellow*, *linear*; *stamens* (*10–*)*15*, *connectival appendage 1½–2x as long as anther*, *ciliate distally*; *ovary and stylopodium ovoid-tapering*, *style glabrous*, *with stylopodium as long as ovary*. **Fruits:** calyx lobes subequal, deltoid, acute, saccate, thickened, to 0.5 × 0.4 cm. **Nuts** obovoid, to 2 × 1.2 cm, mucronate, pubescent or glabrous and shiny.

Vernacular names. Sabah—*banjutan* (preferred name). Sarawak—*lun jantan* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo (common throughout the island). In Sabah known from Beaufort, Kota Kinabalu, Labuk Sugut, Lahad Datu, Semporna, Sipitang, and Tawau districts (e.g., *SAN 15081*, *SAN 15503*, *SAN 16464*, *SAN 38705*, and *SAN 131979*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Limbang, Lubok Antu, Lundu, Marudi, Miri, and Tatau districts (e.g., *S 13761*, *S 23812*, *S 37845*, *S 46588*, and *S 69656*). Also occurring in Brunei (e.g., *BRUN 2630* and *BRUN 5649*) and SE Kalimantan (e.g., *bb. 34427* and *Church et al. 427*).

Ecology. The most abundant of the yellow merantis: in *kerangas*, and mixed dipterocarp forest on the yellow sands of the coastal hills and the inland shale ridges; also on organic soil over karst limestone; but rare or absent from moist clay slopes and the deep friable clays of basic volcanic rocks and calcareous shale, at altitudes to 900 m. In Sabah, common in Sepilok FR and recorded from Kinabalu NP, and in Sarawak, common in Bako, Kubah, Lambir and Mulu NPs; not vulnerable.

Notes. *Shorea hopeifolia* can be confused with this species (see there).

81. **Shorea myrionerva** Symington *ex* P.S.Ashton

(Greek, *myrio-* = countless; Latin, *nervus* = vein; the many-veined leaf blade)

(sect. **Mutica**, subsect. **Auriculatae**, red meranti)

Gard. Bull. Sing. 19 (1962) 299, *op. cit.* (1964) 201, *op. cit.* (1968) 111, *op. cit.* (1982) 530; Meijer & Wood *op. cit.* 122; Burgess *op. cit.* 183; Anderson *op. cit.* (1980) 127; Coode *et al.* (eds.) *op. cit.* 80; Newman *et al. op. cit.* (1996) 173. **Type:** *Drahman S 1519*, Borneo, Sarawak, Lawas district, Merapok (holotype KEP; isotype L).

Canopy, occasionally emergent tree, to 45 m tall, to 1.2 m diameter; bole often leaning; crown loose, generally oblong, the branches pendent with upturned twig endings and hanging leaves; buttresses to 1.5 m but usually less, stout. **Bark** at first smooth, becoming shallowly v-section fissured then powdery flaky, often moss-covered; inner bark yellowish brown; heartwood pinkish brown. *Twig and petiole persistently sparsely coarsely pale fulvous hispid*; *venation below and stipule more shortly so*; *inflorescence sparsely so towards base*; *midrib above*, *stipule and bracteole outside puberulent*; *leaf blade glabrescent*; *other parts glabrous.* **Twigs** terete, straight, few-branched, stout, *c.* 3 mm diameter apically. *Leaf buds imbedded in a loose group of bud scales*, *compressed*, *to 10 × 7 mm*. **Stipules** *broadly hastate*, *subauriculate*, *subpersistent*, *to 17 × 7 mm*. **Leaves** *chartaceous*, *drying reddish brown*; *blade narrowly oblong*, *12–22 × 4.5–9 cm*, *base obtuse*, *apex tapering abruptly*, *acumen to 0.8 cm long*; *midrib obscurely sunken above*, *prominent below*; *lateral veins 24–28 pairs*, *prominent*, *arched towards margin*; *intercostal venation slender*, *scalariform*; *petiole stout*, *1.2–2 cm long.* **Inflorescences** axillary (rarely terminal) to ramiflorous; rachis terete to ribbed on drying, lax, singly branched, the branchlets short bearing to 5 flowers; bracteoles ovate, obtuse, to 8 × 1.5 mm. **Flowers:** buds to 5 × 3 mm; *petals dark red with pale margin*; stamens 15, connectival appendage short, becoming reflexed; ovary and stylopodium narrowly conical to pyriform, style shorter than both, columnar, *glabrous.* **Fruits:** *calyx lobes unequal*, *3 longer lobes oblong*, *obtuse*, *chartaceous*, *to 17 × 2.5 cm*, *not tapering*, *the thickened base surrounded by prominent lateral auricles*, *2 shorter ones linear-lobed*, *to 8 × 0.7 cm*, *saccate but not auriculate.* **Nuts** *ellipsoid*, *to 2.5 × 1.3 cm*, *pruinose*, *with c. 1.5 cm tapering style remnant*.

Vernacular names. Sabah—*seraya urat banyak* (preferred name). Sarawak—*langgai sepit udang* (Iban), *meranti sepit udang* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Beaufort district (e.g., *KEP 80268* and *KEP 80269*) and in Sarawak from Bintulu, Kapit, Lawas, Limbang, Marudi, and Miri districts (e.g., *S 15591*, *S 23302*, *S 29353*, *S 31986*, and *S 43166*). Also occurring in Brunei (e.g., *BRUN 5200* and *BRUN 5218*) and Kalimantan (e.g., *Argent et al. 9492*).

Ecology. Locally common in mixed dipterocarp and riparian forest on moist clay soils on lower hillsides and the banks of both fast and sluggish rivers, at altitudes to 400 m. Occurring in Lambir and Mulu NPs; elsewhere vulnerable owing to the loss of its habitat.

82. **Shorea obovoidea** Slooten

(Latin, *obovoideus* = obovoid; the fruit)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Reinwardtia 3 (1956) 332; Ashton *op. cit.* (1968) 88, *op. cit.* (1982) 477; Anderson *op. cit.* (1980) 122; Newman *et al. op. cit.* (1996) 477. **Type:** *Egon SA 616*, Borneo, Sarawak, Semengoh FR (holotype KEP).

Main canopy tree, to 35 m tall, to 60 cm diameter; bole straight, cylindrical; crown small, dense, hemispherical; buttresses low, stilt roots sometimes present. **Bark** dark tawny-brown, smooth to shallowly patchily flaky. *Leaf bud*, *twig*, *inflorescence*, *parts of perianth exposed in bud*, *and petiole densely somewhat unevenly golden brown puberulent*; *venation below sparsely so*; *ovary and nut evenly buff-pubescent.* **Twigs** terete, slightly rough, *c*. 2 mm diameter apically. Leaf buds ovoid, acute, to 2 × 1 mm. **Stipules** unknown. **Leaves** *coriaceous*, *drying tawny brown below*, *greyish brown above*; *blade elliptic*, *5–13 × 1.7–4.5 cm*, *base cuneate*, *margin minutely revolute*, *apex subcaudate*, *acumen to 1.2 cm long*; *midrib narrowly evident but furrowed above*, *prominent below*; *lateral veins 8–10 pairs*, *arched*, *slender but prominent below*; *intercostal venation subreticulate*, *elevated below*; *petiole slender*, *0.5–1.1 cm long*. **Inflorescences** terminal or axillary; rachis terete, singly branched, branchlets bearing to 5 flowers; bracteole minute, deltoid, acute, *c*. 1 mm long, fugaceous. **Flowers:** *buds small*, *to 3 × 1 mm*; *corolla cream*; *stamens 15*, *connectival appendage slightly longer than anther*; *ovary ovoid*, *without stylopodium*, *style columnar*, *stout*, *slightly shorter than ovary*, *puberulent in the basal half.* **Fruits:** pedicel *c*. 1 mm long; *calyx lobes subequal*, *ovate*, *acute*, *relatively thin*, *hardly saccate*, *to 1.2 × 0.9 cm.* **Nuts** ellipsoid, to 2.3 × 1.6 cm, acute.

Distribution. Endemic in Borneo. Known in Sarawak from Kuching, Kapit and Samarahan districts (e.g., *S 9102*, *S 11072*, *S 14368*, *S 15225*, and *S 67572*). Also occurring in SE Kalimantan (e.g., *bb. 21243*).

Ecology. Very local in mixed dipterocarp forest, on leached sandy clay soil on low hills, at altitudes to 300 m. Endangered by forest conversion.

83. **Shorea obscura** Meijer

(Latin, *obscurus* = obscure; originally confused with *S. atrinervosa*)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

Act. Bot. Neerl. 12 (1963) 333; Meijer & Wood *op. cit.* 184; Ashton *op. cit.* (1964) 142, *op. cit.* (1968) 74, *op. cit.* (1982) 457; Burgess *op. cit.* 203; Anderson *op. cit.* (1980) 120; PROSEA *op. cit.* 432; Coode *et al.* (eds.) *op. cit.* 80; Newman *et al. op. cit.* (1998) 193. **Lectotype** (designated here)**:** *G.H.S. Wood SAN 15166*, Borneo, Sabah, Bt. Sipitang (hololectotype K; isolectotypes KEP, L, SAN).

Emergent tree, to 60 m tall, to 1.3 m diameter; bole tall, straight; crown diffuse cauliflower-shaped, pale from below; buttresses to 6 m tall, thin. **Bark** greyish to reddish brown, closely cracked and evenly oblong flaky. *Leaf venation below*, *petiole*, *twig*, *inflorescence*, *leaf bud*, *parts of perianth exposed in bud*, *stipule*, *bracteole*, *ovary*, *and fruit densely pale buff-brown puberulent*, *caducous except on inflorescence*, *buds*, *stipule and bracteole.* **Twigs** terete, slender, 1.5–2 mm diameter apically. Leaf buds ovoid to falcate, 2–4 × 1.5–2.5 mm. **Stipules** oblong, acute, to 7 × 2.5 mm, caducous. **Leaves** *coriaceous*, *cream lepidote below with the veins drying darker brown*, *drying greyish brown above*; *blade ovate-lanceolate*, *7–12 × 2.5–5 cm*, *base cuneate*, *apex with slender acumen to 1 cm long*; *midrib evident*, *flat or elevated above*, *more prominently so below*; *lateral veins 7–9 pairs*, *arched*, *distinctly raised below*, *intercostal venation scalariform*, *slender*, *hardly elevated*, *obscure*; *petiole slender*, *1.2–2 cm long.* **Inflorescences** terminal or axillary; rachis terete, to 12 cm long, singly branched, branchlets bearing to 5 flowers; bracteoles elliptic-ovate, acute, *c.* 3 mm long, fugaceous. **Flowers:** buds to 6 × 2 mm; *petals bright pink*, *cream at margin*; *stamens 35–45*, *filaments and anthers glabrous*, *connectival appendage almost as long as anther*, *setose*; *ovary and stylopodium ovoid*, *tapering into the short glabrous style.* **Fruits:** *calyx lobes unequal*, *3 longer lobes to 10 × 2 cm*, *tapering 5 mm broad above the saccate base*, *2 shorter ones oblong*, *lobed*, *to 5 × 0.5 cm*, *similar at base.* **Nuts** globose to ellipsoid, to 1.2 × 0.9 cm, abruptly apiculate.

Vernacular names. Sabah—*selangan batu tanduk* (preferred name). Sarawak—*selangan batu padi* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Kota Kinabalu (Gaya Is.), Ranau, Sipitang, Tawau, and Tuaran districts (e.g., *SAN 15166*, *SAN 16772*, *SAN 20651*, *SAN 22370*, and *SAN 99400*) and in Sarawak from Belaga, Limbang, Lundu, and Tatau districts (e.g., *S 1684*, *S 10179*, *S 25011*, *S 28236*, and *S 32331*). Also occurring in Brunei (e.g., *BRUN 5438* and *Prance 30589*) and SE Kalimantan (e.g., *bb. 16966* and *bb. 22911*).

Ecology. Locally frequent in mixed dipterocarp forest on leached sandy clay and well-drained clay soils, especially on spurs and ridges, probably most abundant at 600–800 m altitude, occasionally to 1400 m in upper dipterocarp forest. Occurring in Kinabalu and Mulu NPs; elsewhere vulnerable.

84. **Shorea ochracea** Symington Fig. 26.

(Latin, *ochraceus* = the colour of ochre, warm yellow; the leaf undersurface)

(sect. **Anthoshorea**, white meranti)

Gard. Bull. S. S. 8 (1935) 285; Masamune *op. cit.* 495; Browne *op. cit.* 158; Ashton *op. cit.* (1964) 165, *op. cit.* (1968) 94, *op. cit.* (1982) 492; Meijer & Wood *op. cit.* 57; Burgess *op. cit.* 159; Anderson *op. cit.* (1980) 123; PROSEA *op. cit.* 412; Coode *et al.* (eds.) *op. cit.* 80; Newman *et al. op. cit.* (1996) 174. **Lectotype** (designated here)**:** *Spurway S 167*, Borneo, Sarawak, Baleh, Merirai (hololectotype KEP).

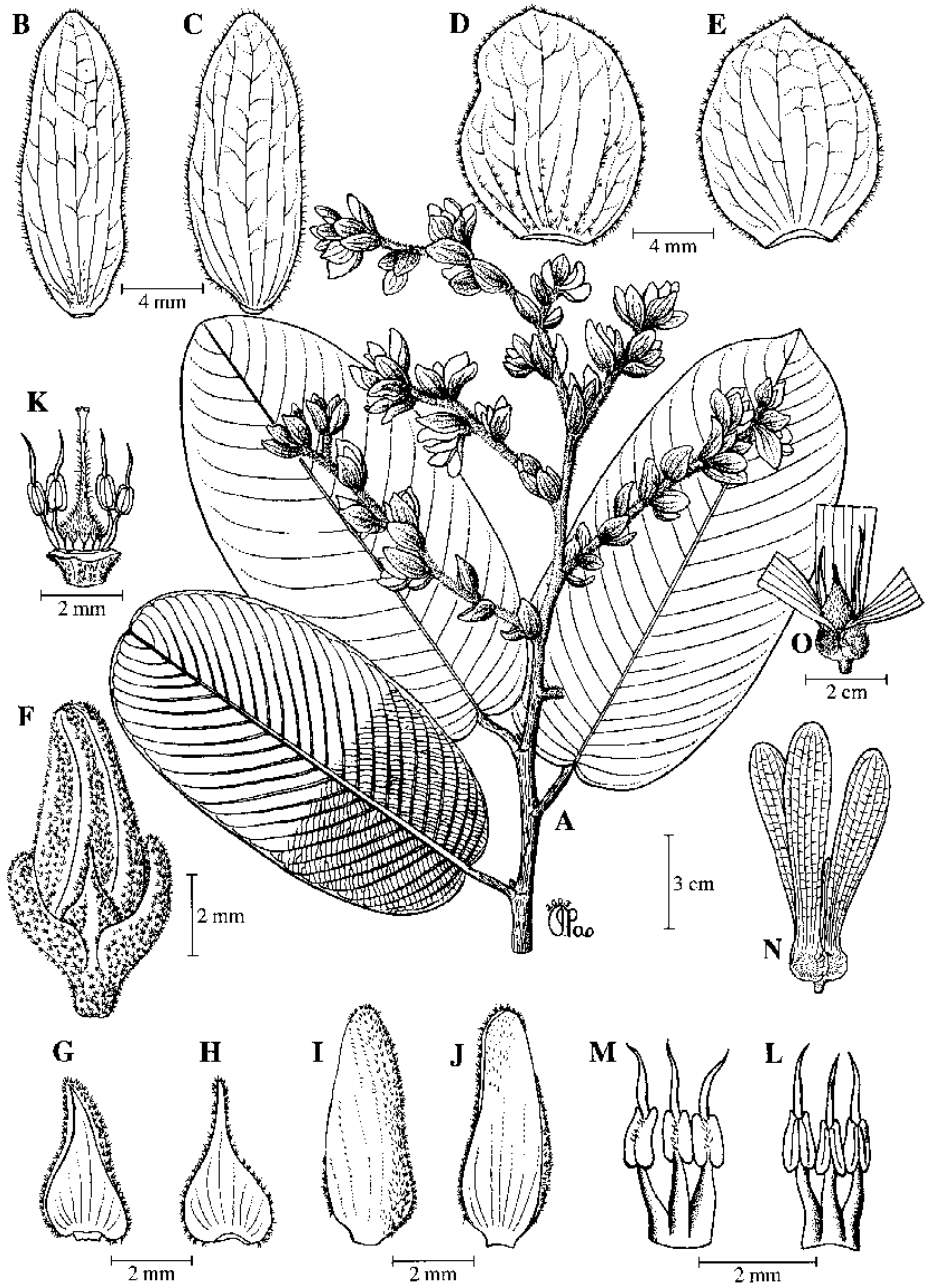

Fig. 26. *Shorea ochracea*. A, leafy twig with young shoots; B, abaxial view of bract; C, adaxial view of bract; D, abaxial view of bracteole; E, adaxial view of bracteole; F, flower bud; G, adaxial view of outer sepal; H, adaxial view of inner sepal; I, abaxial view of petal; J, adaxial view of petal; K, gynoecium and stamens; L, adaxial view of stamens; M, abaxial view of stamens; N, fruit; O, fruit with the nut partially exposed. (A from *S 32359*, B–O from *BRUN 3274*.)

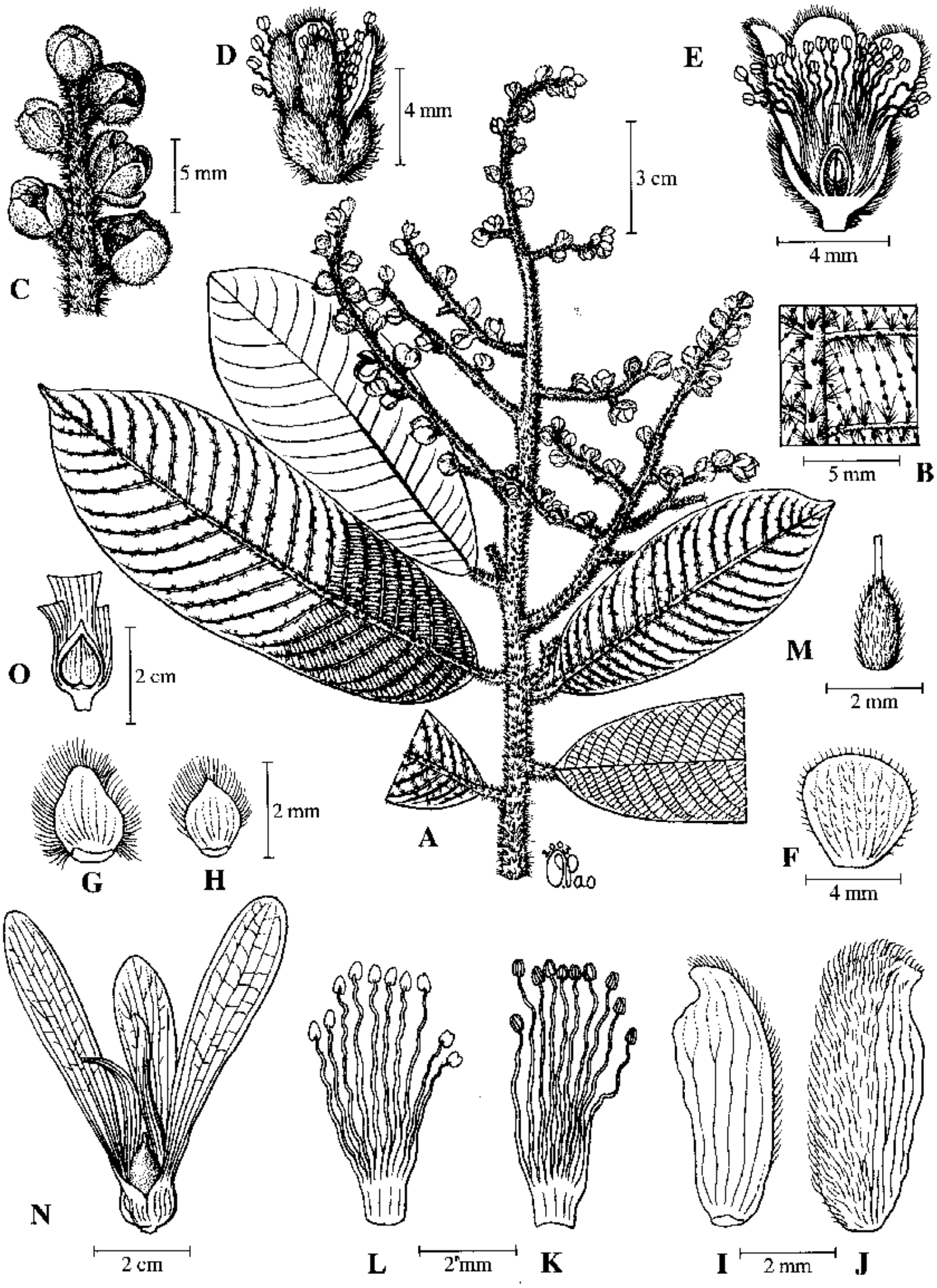

Fig. 27. *Shorea ovalis*, subsp. *ovalis* (N–O) and subsp. *sarawakensis* (A–M). A, flowering leafy twig; B, detail of venation and indumentum on lower leaf surface; C, portion of inflorescence; D, opening flower; E, longitudinal section of open flower; F, abaxial view of bract; G, adaxial view of outer sepal; H, adaxial view of inner sepal; I, adaxial view of petal; J, abaxial view of petal; K, adaxial view of stamens; L, abaxial view of stamens; M, gynoecium; N, fruit; O, longitudinal section of fruit. (A–M from *S 15159*, N–O from *SAN 16474*.)

Large emergent tree, to 50 m tall, to 1.3 m diameter; bole straight or malformed; crown irregularly hemispherical, dense, large-leaved, pale yellowish from below; buttresses to 1.5 m tall, very stout. **Bark** mottled pale brown, becoming deeply prominently irregular-section fissured and eventually crumbly flaky, dark chocolate-brown; inner bark pale yellowish brown and cream-yellow laminated; dammar pale cream-yellow, as smears on bole. *Twig, leaf bud, inflorescence, parts of perianth exposed in bud, fruit calyx, stipule, bracteole, and petiole densely persistently rufous brown or greenish yellow powdery pubescent, partially caducous, sparse on leaf below; ovary and nut densely evenly cream pubescent.* **Twigs** terete, with horizontal or ascending stipule scars, stout, 4–5 mm diameter apically. *Leaf buds globose to ovoid, obtuse, 3–6 × 3–5 mm.* **Stipules** *elliptic, obtuse, to 20 × 15 mm, caducous.* **Leaves** *thickly coriaceous and somewhat turned up along the midrib, bright yellow lepidote below* (mature trees); *blade broadly elliptic-oblong, 12–18 × 7–10 cm* (*larger in juveniles*), *base cordate, apex with broad acumen to 0.5 cm long; midrib obscure, sunken, above, prominently terete below; lateral veins 25–30 pairs, dense, arched, prominent below; intercostal venation densely scalariform, obscure; petiole stout, 1.3–2 cm long.* **Inflorescences** terminal or axillary; rachis terete, lax, to 10 cm long, branchlets bearing to 8 flowers; bracteoles large, elliptic, obtuse, subpersistent, to 20 × 10 mm. **Flowers:** buds to 8 × 3 mm; *stamens 15, anther oblong, tapering, connectival appendage somewhat longer than anther; ovary ovoid, without stylopodium, style glabrous except towards base, as long as ovary.* **Fruits:** *calyx lobes unequal, 3 longer lobes to 10 × 2 cm, oblong, tapering to 1 cm above the narrowly auriculate centrally thickened base, 2 shorter ones to 4.5 × 0.5 cm, unequal, otherwise similar.* **Nuts** ovoid, to 1.5 × 1 cm, with to 2.5 mm style remnant.

Vernacular names. Sabah—*melapi daun besar* (preferred name). Sarawak—*raruk* (Iban).

Distribution. Endemic in Borneo. In Sabah recorded from Beaufort, Kinabatangan, Sipitang, and Tawau districts (e.g., *SAN 15229*, *SAN 16813*, *SAN 19537*, *SAN 27974*, and *SAN 93773*) and in Sarawak from Belaga, Bintulu, Kapit, Limbang, and Miri districts (e.g., *S 15117*, *S 29685*, *S 32359*, *S 46447*, and *S 69173*). Also occurring in Brunei (e.g., *BRUN 3274* and *BRUN 5434*) and W and NE Kalimantan (e.g., *Arifin Berau 1092* and *Kessler et al. Berau 891*).

Ecology. Scattered, usually as isolated individuals, in mixed dipterocarp forest on undulating land and hills, on sandy clay and clay soils, at altitudes to 750 m. Occurring in Lambir and Mulu NPs; elsewhere vulnerable owing to both land conversion and logging.

85. **Shorea ovalis** (Korth.) Blume Fig. 27.

(Latin, *ovalis* = oval; the leaf shape)

(sect. **Ovalis**, red meranti)

Mus. Bot. Lugd.-Bat. 2 (1852) 33; Merrill *op. cit.* (1921) 406; Symington *op. cit.* (1939) 370, *op. cit.* (1943) 80; Masamune *op. cit.* 495; Browne *op. cit.* 132; Ashton *op. cit.* (1963) 274, *op. cit.* (1982) 548; Meijer & Wood *op. cit.* 125 *p.p.*; Burgess *op. cit.* 154, 183; PROSEA *op. cit.* 398; Kessler & Sidiyasa *op. cit.* 106; Newman *et al. op. cit.* (1996) 176. **Basionym:** *Vatica ovalis* Korth., Kruidk. (1841) 73. **Type:** *Korthals s.n.* (= *RHL Sheet No. 902146618*), Borneo, Kalimantan, Prarawing (holotype L). **Synonyms:** *Vatica eximia* Miq., *op. cit.* 486; *V. sublacunosa* Miq., *op. cit.* 486; *Hopea aspera* de Vriese *op. cit.* 28; *Shorea eximia* (Miq.) Scheff., Nat. Tijd. Ned. Ind. 31 (1870) 349; *S. eximia* (Miq.) Scheff. var. *angustifolia* Burck *op. cit.* (1887) 218; *S. sublacunosa* (Miq.) Scheff., *op. cit.* 350.

Large emergent tree, to 50 m tall, to 1.3 m diameter; bole tall, cylindrical; crown hemispherical, rather even, with many ascending branches; buttresses to 1.5 m tall, stout. **Bark** pale pinkish brown and grey mottled, becoming shallowly v-section fissured, eventually patchily powdery flaky; inner bark pale reddish brown; heartwood pink, relatively light. *Twig*, *inflorescence*, *parts of perianth exposed in bud*, *stipule*, *bracteole*, *petiole*, *and leaf below densely persistently scabrid-puberulent to coarsely pubescent or tufted tomentose or sparsely so*; *ovary and nut densely evenly pubescent*; *fruit calyx sparsely puberulent.* **Twigs** terete, straight, sparingly branched, stout, *c.* 3 mm diameter apically; stipule scars cuneate, slightly ascending. Leaf buds ovoid, obtuse, to 8 × 6 mm. **Stipules** *ovate*, *acute*, *prominently veined*, *to 13 × 7 mm*, *subpersistent*. **Leaves** *coriaceous*, *weakly blistered in juveniles*, *drying rich reddish brown below*, *pink-mauve above*; *blade narrowly oblong-ovate*, *10–18 × 3–7 cm*, *or narrowly oblong*, *12–17 × 2–4.5 cm*, *base obtuse*, *margin more or less narrowly revolute*, *apex with narrow acumen*, *to 0.8 cm long*; *midrib narrowly evident but furrowed above*, *prominent below*; *lateral veins* (*20–*)*22–25 pairs*, *prominent below*, *arched*, *dense*; *intercostal venation distinctly elevated*, *scalariform*; *petiole 0.7–0.9 cm long.* **Inflorescences** *terminal or axillary*; rachis *rigid*, *to 18 cm long*, *branchlets compact bearing to 8 flowers*; bracteole broadly elliptic, obtuse, to 8 × 6 mm, concave round bud. **Flowers:** *buds broadly ovoid to subglobose*, *to 5 mm long*; petals cream, pink-tinged at base; *stamens 50–70*, *connectival appendage short*, *vestigial*; ovary and stylopodium narrowly conical, style short, cylindrical, glabrous. **Fruits:** *calyx lobes unequal*, *3 longer lobes to 11 × 1.4 cm*, *tapering to 7 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 6 × 0.4 cm*, *similar at base*. **Nuts** ovoid, to 2.2 × 1.3 cm, with to 2.5 mm tapering style remnant.

Vernacular names. Sabah—*seraya kepong* (preferred name), Sarawak—*meranti kepong* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo.

Ecology. Frequent, sometimes common in mixed dipterocarp forest on fertile well-structured clay soils, on low hills, at altitudes to 500 m.

Notes. Two species, *viz.* subsp. *ovalis* and subsp. *sarawakensis*, are recognised.

Key to subspecies

Twigs and inflorescences densely persistently scabrid-puberulent to coarsely pubescent. Leaf blade narrowly oblong-ovate, 10–18 × 3–7 cm, densely scabrid-pubescent below; margin more or less revolute……………………………………………………………………..

subsp. **ovalis**

Absent from Brunei, Sarawak and W Sabah but widespread in E Sabah and known from Kinabatangan, Sandakan and Tawau districts (e.g., *SAN 16474*, *SAN 20906*, *SAN 23973*, *SAN 39114*, and *SAN 63079*). Also occurring in E and SE Kalimantan (e.g., *Ambriansyah & Arifin Berau 1072*, *bb. 34377*, *Meijer 2198*, and *Meijer 2222*). Ecology as the species. Occurring in Sepilok FR; elsewhere vulnerable owing to land conversion.

Twigs and inflorescences prominently tufted tomentose, tufts to 3 mm long. Leaf blade narrowly oblong, 12–17 × 2–4.5 cm, glabrous below; margin prominently revolute………...

subsp. **sarawakensis** P.S.Ashton
(of Sarawak)

Gard. Bull. Sing. 20 (1963) 275, *op. cit.* (1968) 111, *op. cit.* (1982) 549; Meijer & Wood *op. cit.* 126, *p.p.*; Burgess *op. cit.* 154, 183; Anderson *op. cit.* (1980) 127; PROSEA *op. cit.* 398; Coode *et al.* (eds.) *op. cit.* 80; Newman *et al. op. cit.* (1996) 177. Type: *Ashton BRUN 3281*, Borneo, Brunei, Andulau FR (holotype K; isotype KEP).

Endemic in Borneo; recorded in Sabah from Beaufort, Kota Merudu, Lahad Datu, Ranau, Sandakan, Semporna, Sipitang, and Tawau districts (e.g., *SAN 15182*, *SAN 16364*, *SAN 17850*, *SAN 18301*, and *SAN 63754*) and in Sarawak from Kuching, Lundu and Miri districts (e.g., *S 15159*, *S 29472*, *S 37800*, *S 46492*, and *S 49957*). Also occurring in Brunei (e.g., *BRUN 3281* and *S 1652*) and NW Kalimantan (e.g., *Suzuki K 9758*). As subsp. *ovalis*, but usually as scattered individuals, on leached clay and sandy clay soils. Occurring in Kubah, Lambir and Mulu NPs; not vulnerable.

86. **Shorea ovata** Dyer *ex* Brandis

(Latin, *ovatus* = ovate; the leaf shape)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

J. Linn. Soc. Bot. 31 (1895) 91; Merrill *op. cit.* (1921) 406; Symington *op. cit.* (1933) 140, *op. cit.* (1943) 82; Masamune *op. cit.* 495; Browne *op. cit.* 148; Ashton *op. cit.* (1964) 230, *op. cit.* (1968) 112, *op. cit.* (1982) 545; Meijer & Wood *op. cit.* 127; Burgess *op. cit.* 166; Anderson *op. cit.* (1980) 127; PROSEA *op. cit.* 398; Coode *et al.* (eds.) *op. cit.* 179. **Lectotype** (designated here)**:** *Curtis 201*, Peninsular Malaysia, Penang Hill (hololectotype K). **Synonyms:** *Shorea plagata* Foxw., *op. cit.* (1918) 192; *S. agsaboensis* W.L. Stern, Brittonia 17 (1965) 36.

Main canopy or low emergent tree, occasionally to 50 m tall, to 1.4 m diameter but usually shorter; bole straight, cylindrical; crown hemispherical to cauliflower-shaped, usually with many radiating branches; buttresses to 1 m tall, usually short, stout. **Bark** at first mottled fawn, dark brown and ochreous reminiscent of *Calophyllum*, becoming deeply closely v-section fissured; inner bark deep pink to dark meat-red; heartwood dark reddish brown. *Young twig*, *inflorescence*, *parts of calyx exposed in bud*, *leaf bud*, *stipule*, *bracteole*, *petiole*, *midrib above*, *and leaf below densely persistently evenly ochreous to rust-puberulent*, *scabrous on inflorescence and venation below*, *sparsely so on fruit calyx*; *nut yellowish brown pubescent*. **Twigs** much-branched, terete, slender, *c*. 1 mm diameter apically; stipule scars short, descending. Leaf buds ovoid, obtuse, 3–6 × 1.5–3 mm. **Stipules** ovate, subacute, to 13 × 5 mm, caducous. **Leaves** *coriaceous*, *drying ashen-brown below*, *mauve-brown above*; *blade broadly ovate*, *4–8 × 2.5–4.5 cm*, *base subequal*, *obtuse*, *margin subrevolute*, *apex with narrow acumen to 1 cm long*; *midrib obscurely sunken above*, *prominent below*; *lateral veins 8–10 pairs*, *prominent below*, *arched*, *with small pilose axillary domatia*; *intercostal venation hardly elevated*, *slender*, *densely scalariform*; *petiole 1–1.5 cm long*. **Inflorescences** terminal or axillary; rachis terete or slightly compressed, to 11 cm long, branchlets bearing to 8 flowers; bracteoles oblong, obtuse, to 3.5 × 2 mm. **Flowers:** petals pale pink with cream margin; *stamens 15*, *or 10 by abortion of outer 5*, *connectival appendage short*, *becoming reflexed*; *ovary ovoid*, *without stylopodium*, *tapering into the short glabrous style*. **Fruits:** *calyx lobes unequal*, *3 longer lobes to 5.5 × 1 cm*, *tapering to 4 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 3 × 0.3 cm*, *otherwise similar*. **Nuts** broadly ovoid, to 1.1 × 0.8 cm; style remnant tapering, to 2.5 mm long.

Vernacular names. Sabah—*seraya punai bukit* (preferred name). Sarawak—*meranti pitis* (preferred name).

Distribution. Sumatra, Peninsular Malaysia, Borneo, and the Philippines (Mindanao). Widespread in Borneo though not in the south. In Sabah recorded from Kota Belud, Sipitang and Tambunan districts (e.g., *KEP 80407*, *KEP 80433*, *SAN 15130*, and *SAN 16263*) and in Sarawak from Bintulu, Kuching, Lundu, Miri, Samarahan, and Simunjan districts (e.g., *S 15240*, *S 15542*, *S 17046*, *S 27765*, and *S 32052*). Also occurring in Brunei (e.g., *BRUN 551* and *Niga NN 227*).

Ecology. Locally common, in mixed dipterocarp forests on yellow sandy soil in the lowlands; also in the ecotone to *kerangas*, and in upper dipterocarp forest, at 600–1000 m altitude. Common in Bako NP and frequent in Kinabalu, Kubah, Lambir and Mulu NPs; elsewhere vulnerable in the lowlands owing to land conversion.

87. **Shorea pachyphylla** Ridl. *ex* Symington

(Greek, *pachy-* = thick, *phullon* = leaf; the leathery leaf)

(sect. **Brachyptera**, red meranti)

J. Malay. Br. Roy. As. Soc. 19 (1941) 163; Browne *op. cit.* 148; Anderson *op. cit.* (1963) 159, *op. cit.* (1980) 128; Ashton *op. cit.* (1964) 205, *op. cit.* (1968) 112, *op. cit.* (1982) 511; PROSEA *op. cit.* 399; Coode *et al.* (eds.) *op. cit.* 81; Newman *et al. op. cit.* (1996) 180. **Type:** *Haviland 2228*, Borneo, Sarawak, near Kuching (holotype SING; isotype L).

Emergent tree, to 45 m tall, to 1.5 m diameter; bole cylindrical, often tapering; crown dense, irregularly hemispherical with a few large twisted branches; buttresses to 2.5 m tall, prominent, stout. **Bark** pinkish to mauve-brown, becoming deeply v-section fissured, the intervening ridges thinly flaky; inner bark yellowish brown; heartwood coffee-coloured, rather hard. *Exposed young parts evenly densely tawny puberulent*, *caducous on all but leaf bud*, *inflorescence and petal outside*, *sparse on stipule and bracteole*; *other parts glabrous.* **Twigs** terete to slightly compressed, ridged, stout, *c.* 4 mm diameter apically; *stipule scars horizontal*, *long to amplexicaul.* Leaf buds narrowly ovoid to broadly falcate, 5–8 × 2–4 mm. **Stipules** lanceolate, to 20 × 7 mm, fugaceous. **Leaves** *thickly coriaceous*, *shiny and drying rich tawny below*, *greyish brown above*; *blade broadly ovate to suborbicular*, *10–20 × 9–16 cm*, *base obtuse or broadly cuneate*, *margin slightly but distinctly revolute*, *apex obtuse or with broad acumen to 0.5 cm long*; *midrib obscure*, *sunken above*, *stoutly prominent below*; *lateral veins 7–9 pairs*, *well-spaced*, *arched at margin*, *stoutly prominent below*; *intercostal venation slender*, *hardly elevated*, *densely scalariform*; *petiole 4–6 cm long*, *stout*, *hardly geniculate.* **Inflorescences** terminal or axillary; rachis compressed, to 11 cm long, doubly branched, branchlets bearing to 5 flowers; bracteoles ovate, acute, to 3 × 2 mm. **Flowers:** buds to 6 × 4 mm; *stamens 15*, *connectival appendage 3–4x as long as anther*; *ovary ovoid*, *without distinct stylopodium*, *style as long as ovary*, *filiform.* **Fruits:** calyx glabrous, *lobes unequal*, *3 longer lobes to 16 × 3.5 cm*, *tapering to c. 7 mm broad above the to 2 × 1.5 cm saccate base*, *2 shorter ones to 8 × 0.6 cm*, *otherwise similar.* **Nuts** *ovoid*, *pruinose*, *to 3.3 × 1.8 cm*, *with c. 1.5 mm long tapering style remnant.*

Vernacular names. Sarawak—*kerukup* (Malay), *meranti kerukup* (preferred name).

Distribution. Endemic in Borneo. Widespread where its habitat occurs; unknown from Sabah. In Sarawak recorded from Bintulu, Kuching, Lundu, Marudi, Miri, Samarahan, Sibu and Tatau districts (e.g., *FMS 7173*, *S 9316*, *S 11245*, and *S 11753*). Also occurring in

Brunei (e.g., *BRUN 695*, *BRUN 5531*, *FMS 30556*, *Niga NN 116*, and *S 7882*) and Kalimantan (e.g., *bb. 17310*).

Ecology. Locally common, in mixed peat swamp forest and in *kerangas* forest on poorly drained podsols. Endangered by forest conversion.

88. **Shorea palembanica** Miq.

(of Palembang, Sumatra)

(sect. **Brachyptera**, red meranti)

Fl. Ned. Ind., Suppl. (1861) 487; Symington *op. cit.* (1933) 141, *op. cit.* (1943) 83; Masamune *op. cit.* 496; Browne *op. cit.* 141; Ashton *op. cit.* (1968) 112, *op. cit.* (1982) 513; Anderson *op. cit.* (1980) 128; PROSEA *op. cit.* 181; Newman *et al. op. cit.* (1996) 181. **Type:** *Teijsmann s.n.* (= *Herb. Utrecht no. 35907*), Sumatra, Palembang (holotype U). **Synonyms:** *Shorea aptera* Burck *op. cit.* 210; *S. brachyptera* F.Heim *op. cit.* (1891) 571; *Pachychlamys beccarianus* Dyer *ex* Brandis *op. cit.* 77; *P. brachypterus* Dyer *ex* Brandis *op. cit.* 77.

Main canopy tree, rarely large, to 45 m tall, to 1.3 m diameter; bole often leaning or misshapen, often mossy; crown dense, irregularly oblong to hemispherical; buttresses stout. **Bark** dark greyish brown, overall smooth, at first hoop-marked, becoming irregularly cracked and shallowly patchily flaky; inner bark pinkish brown to cream at cambium; heartwood pale pink, fairly soft. *Young twig*, *inflorescence*, *leaf bud*, *parts of perianth exposed in bud*, *stipule and bracteole outside*, *ovary and nut*, *and midrib above densely evenly pale buff-puberulent*; *stipule and bracteole inside*, *petiole and leaf venation below sparsely so*, *more or less glabrescent.* **Twigs** *compressed*, *c.* 2 mm diameter *apically*. Leaf buds lanceolate-falcate, to 13 × 6 mm. **Stipules** lanceolate, to 15 × 3 mm, caducous. **Leaves** *chartaceous*, *drying dark chocolate-brown below*, *purplish brown above*, *undulating*; *blade ovate to oblong*, 8–25 × 4–10 cm, *base broadly cuneate to subcordate*, *apex with broad acumen to 1 cm long*; *midrib slender but evident*, *shallowly furrowed or flat above*, *prominent below*; *lateral veins 12–16 pairs*, *slender but prominent below*; *intercostal venation scalariform*, *slender*, *dense*; *petiole 1.4–2.5 cm long.* **Inflorescences** terminal or axillary; rachis terete, doubly branched, branchlets bearing to 10 flowers; bracteoles ovate, acute, to 4 × 2 mm, caducous. **Flowers:** buds to 7 × 3 mm; *petals pale yellow*; *stamens 15*, *connectival appendage c. 2x as long as anther*; *ovary ovoid*, *without stylopodium*, *style c. 2x as long as ovary*, *filiform*, *pubescent in the basal quarter.* **Fruits:** pedicel to 2 mm long; *calyx lobes unequal but short*, *3 longer lobes lorate*, *to 5 × 0.7 cm above the saccate base*, *2 shorter ones to 3 cm long*, *otherwise similar.* **Nuts** ovoid, to 3.5 × 2.5 cm, apiculate.

Vernacular name. Sarawak—*engkabang asu* (preferred name).

Distribution. E Sumatra, Peninsular Malaysia and Borneo. In Sabah known from Beluran, Sandakan, Semporna, and Tawau districts (e.g., *SAN 9264*, *SAN 24288* and *SAN 32503*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lundu, Marudi, Miri, Samarahan, Sibu, Simunjan, and Tatau districts (e.g., *S 15587*, *S 22289*, *S 23384*, *S 53529*, and *S 76331*). Also occurring in Kalimantan (e.g., *bb. 29273*, *Endert 4935* and *Kostermans 12686*). Vulnerable owing to forest conversion.

Ecology. Locally frequent on silty floodplains and hanging over the banks of sluggish rivers. Occurring in Kubah NP; elsewhere vulnerable owing to land conversion.

Uses. A minor source of illipe nuts.

89. **Shorea pallidifolia** P.S.Ashton

(Latin, *pallidus* = pale, *folius* = leaf; the pale leaf undersurface)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

Gard. Bull. Sing. 22 (1967) 296, *op. cit.* (1968) 113, *op. cit.* (1982) 551; Anderson *op. cit.* (1980) 128; Newman *et al. op. cit.* (1986) 182. **Type:** *Rashid S 16054*, Borneo, Sarawak, Bako NP (holotype K; isotypes KEP, L).

Canopy tree, to 40 m tall, to 80 cm diameter; bole cylindrical, short; crown conical to hemispherical, pale from below, dense; buttresses to 1.5 m long, stout. **Bark** pale pinkish to greyish brown, becoming shallowly v-section fissured; inner bark pale yellowish brown, faintly laminated; heartwood pinkish brown, quite hard. *Twig*, *leaf bud*, *stipule*, *inflorescence*, *parts of calyx exposed in bud*, *petiole*, *and venation below persistently pale yellowish brown scabrid-pubescent*; *outside of petal and nut evenly cream-buff pubescent.* **Twigs** compressed and ribbed at first, stout, *c.* 6 × 3 mm apically. Leaf buds broadly ovoid-conical, compressed, to 10 × 8 mm. **Stipules** oblong, obtuse, to 7 × 5 mm. **Leaves** *thickly coriaceous*, *cream lepidote below* (mature trees); *blade broadly oblong to ovate or obovate*, *13–22 × 7–13 cm*, *base obtuse or subcordate*, *apex with short acumen*; *midrib obscure and sunken above*, *prominent below*; *lateral veins 12–19 pairs*, *prominent below*, *arched*; *intercostal venation densely scalariform*, *hardly elevated below*; *petiole stout*, *2–3.5 cm long*. **Inflorescences** axillary; rachis terete, shortly singly branched, branchlets bearing to 4 flowers. **Flowers:** buds to 6 × 4 mm; petals pinkish yellow; stamens 15; ovary ovoid, without stylopodium, glabrous, with somewhat longer columnar glabrous style. **Fruits:** pedicels *c.* 1 mm long; *calyx lobes unequal*, *3 longer lobes to 7 × 1.5 cm*, *tapering to c. 7 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 4 × 0.3 cm*, *similar but smaller at base*. **Nuts** ovoid, to 1.2 × 0.9 cm, shortly apiculate.

Distribution. Endemic in Borneo. Known in Sarawak from Kuching, Lundu and Serian districts (e.g., *KEP 79314*, *S 6161*, *S 9315*, *S 13357*, and *S 22768*); also observed but not collected in the low hills between the lower Mukah and Balingian rivers. Also occurring in W Kalimantan north of Sg. Kapuas.

Ecology. Very local, rare overall, in *kerangas* on white sand terraces and over sandstone. Locally frequent in Bako NP; endangered elsewhere.

90. **Shorea parvifolia** Dyer

(Latin, *parvus* = small, *folius* = leaf)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

Fl. Br. Ind. 1 (1874) 306; Slooten *op. cit.* (1929) 203; Symington *op. cit.* (1933) 137, *op. cit.* (1943) 85; Masamune *op. cit.* 496; Browne *op. cit.* 141; Ashton *op. cit.* (1963) 277, *op. cit.* (1964) 206, *op. cit.* (1968) 113, *op. cit.* (1982) 546; Meijer & Wood *op. cit.* 128; Burgess *op. cit.* 155, 183; Anderson *op. cit.* (1980) 128; PROSEA *op. cit.* 399; Kessler & Sidiyasa *op. cit.* 107; Newman *et al. op. cit.* (1996) 183. **Type:** *Maingay 1577* (= *Kew Distr. No. 206*), Peninsular Malaysia, Malacca (holotype K; isotype L). **Synonyms:** *Shorea scutulata* King *op. cit.* 110; *S. gentilis* Parijs *op. cit.* 244.

Large emergent tree, to 65 m tall, to 2 m diameter; bole tall, cylindrical; crown immense, cauliflower-shaped; buttresses to 4 m tall, stout. **Bark** at first remaining smooth, dappled dark brown mottled with grey, becoming shallowly or deeply v-section fissured, chocolate-brown, eventually crumbly flaky towards the base; inner bark rich reddish brown; heartwood deep pink to reddish brown; dammar smears cream, abundant. *Young twig*, *inflorescence*, *leaf bud*, *parts of perianth exposed in bud*, *stipule*, *bracteole*, *petiole and midrib above evenly pale brown puberulent*, *persistent or glabrous*; *ovary and nut buff pubescent.* **Twigs** terete, *c.* 2 mm diameter apically. Leaf buds ovoid, obtuse, to 3 × 2 mm. **Stipules** broadly ovate, obtuse, to 6 × 4 mm, caducous. **Leaves** *thinly coriaceous*, *drying chocolate-brown below*, *mauve-brown above*, veins glabrous or sparsely scabrid-pubescent below; *blade broadly ovate*, *ovate*, *or elliptic*, 5–11 × 2.5–6 cm, *base obtuse*, *cordate*, or *cuneate*, *sometimes with one or more pairs of opposite glabrous pale pit- or scale-like basal domatia*, *apex with acumen to 1 cm long*; *midrib obscure*, *sunken above*, *slender but prominent below*; *lateral veins 10–13 pairs*, *slender*, *hardly elevated or prominent below*; *intercostal venation slender*, *densely scalariform*, *hardly elevated*; *petiole 1–1.5 cm long.* **Inflorescences** terminal or axillary; rachis slender, terete or slightly compressed, to 12 cm long, branchlets short, bearing to 8 dense flowers; bracteole elliptic-oblong, obtuse, to 6 × 3 mm. **Flowers:** buds to 7 × 5 mm; petals cream suffused with pink at base; stamens 15, connectival appendage short, slender, becoming reflexed; ovary and stylopodium ovoid-conical, surmounted by short glabrous style. **Fruits:** *calyx lobes unequal*, *3 longer lobes chartaceous*, *to 9 × 1.5 cm*, *tapering to c. 4 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 3.5 × 0.2 cm*, *similar at base*. **Nuts** ovoid, to 1.4 × 0.7 cm, with to 2.5 mm tapering style remnant.

Vernacular names. Sabah—*seraya punai* (preferred name). Sarawak—*meranti sarang punai* (preferred name).

Distribution. Peninsular Thailand (Pattani), Peninsular Malaysia, Sumatra, and Borneo.

Ecology. Common where it occurs, in mixed dipterocarp forest on yellow clay soils, usually well-drained, on shales and intermediate and acid volcanic rocks, but rare on base rich rocks such as basalt.

Notes. Two subspecies, *viz.* subsp. *parvifolia* and subsp. *velutina*, are recognised.

Key to subspecies

Bark becoming shallowly v-section fissured. Leaf blade broadly ovate, base obtuse or cordate, margin slightly revolute; veins glabrous and hardly elevated below………………...

> subsp. **parvifolia**
>
> Sumatra, Peninsular Malaysia and Borneo. In Borneo occurring throughout the uplands, but confined to Tawau district in Sabah (e.g., *Elmer 21401* and *Elmer 21530*) and Belaga and Kapit districts in Sarawak (e.g., *S 29354* and *S 29509*). Vulnerable owing to land conversion.

Bark becoming deeply v-section fissured. Leaf blade ovate or elliptic, base obtuse or cuneate, margin frequently narrowly revolute; veins sparsely scabrid-pubescent and prominent below……………………………………………………………………………..

subsp. **velutinata** P.S.Ashton

(Latin, *velutinatus* = somewhat velvety; the indumentum)

Gard. Bull. Sing. 20 (1963) 278, *op. cit.* (1982) 547; Newman *et al. op. cit.* (1996) 185. Type: *Awang Lela FMS 4502*, Peninsular Malaysia, Pahang, Temerloh, Belingo FR (holotype KEP).

E Sumatra, Peninsular Malaysia east of the main range (known there as the "Pahang Form") and Borneo. In Borneo, widespread, and the prevailing form in Sabah (e.g., *SAN 21627* and *SAN 36950*) and Sarawak (e.g., *S 9612* and *S 29673*).

With *S. leprosula* the commonest red meranti in the mixed dipterocarp forest; with a similar ecological range and co-occurring with that species, but tending to be prevalent on slightly more leached soils, particularly in the lowlands near to the coast. In Sabah, common in Danum Valley Conservation Area and Sepilok FR and occurring in Kinabalu NP, and in Sarawak, common in G. Gading, Lambir and Mulu NPs; not vulnerable.

91. **Shorea parvistipulata** F.Heim

(Latin, *parvus* = small, *stipulatus* = with stipules; the small stipules)

(sect. **Brachypterae**, red meranti)

Bull. Mens. Soc. Linn. Paris 2 (1891) 974; Merrill *op. cit.* (1921) 406 ('*parvistipula*'); Masamune *op. cit.* ('*parvistipula*'); Meijer & Wood *op. cit.* 132; Burgess *op. cit.* 184; Ashton *op. cit.* (1968) 114, *op. cit.* (1978) 46, *op. cit.* (1982) 508; Anderson *op. cit.* (1980) 128; Kessler & Sidiyasa *op. cit.* 108; Coode *et al.* (eds.) *op. cit.* 81; Newman *et al. op. cit.* (1996) 185. **Type:** *Beccari PB 2547*, Borneo, Sarawak, Matang (holotype P). **Synonyms:** *Shorea cristata* Brandis *op. cit.* 97, Ashton *op. cit.* (1964) 184, *op. cit.* (1968) 106, Meijer & Wood *op. cit.* 102, Burgess *op. cit.* 166, Anderson *op. cit.* (1980) 125; *S. nebulosa* Meijer *op. cit.* 337, Meijer & Wood *op. cit.* 123, Burgess *op. cit.* 183.

Huge emergent tree, to 70 m tall, to 2 m diameter; bole tall, straight, cylindrical; crown vast, diffuse but regularly hemispherical; buttresses to 5 m tall, prominent, stout. **Bark** mauve-brown, at first smooth, becoming shallowly cracked and flaky, eventually scalloped, prominently pale lenticellate; inner bark pale chocolate-brown; heartwood pink; dammar smears occasional, cream. *Leaf bud*, *parts of perianth exposed in bud*, *twig*, *inflorescence*, *stipule and bracteole outside*, *petiole and leaf venation below persistently pale yellowish to greyish brown scabrid-pubescent*; *stipule and bracteole inside and midrib above evenly so.* **Twigs** terete, *c.* 2 mm diameter apically; stipule scars pale, short, horizontal or ascending. Leaf buds ovoid, acute, to 6 × 4 mm. **Stipules** ovate, subacute, to 14 × 7 mm. **Leaves** *chartaceous*, *drying rust- to chocolate-brown below*, *mauve-brown above*; *blade variable*, *more or less oblong*, *base cordate*, *sometimes obtuse or cuneate*, *apex with tapering acumen to 1 cm long*; *midrib evident*, *flat or shallowly furrowed above*, *prominent below*; *lateral veins 13–21 pairs*, *prominent below*; *intercostal venation scalariform*, *well-spaced*; *petiole 1.2–1.5 cm long.* **Inflorescences** terminal or axillary; rachis terete, straight, lax, to 16 cm long, branchlets to 4 cm long bearing to 11 flowers; bracteoles deltoid, acute, to 5 × 3 mm, not at first caducous. **Flowers:** buds to 7 × 3 mm; petals cream suffused with pink at base; *stamens 15*, *connectival appendage c. 2x the length of anther*; *ovary ovoid*, *stylopodium obscure*, *style equal to ovary*, *filiform*, *glabrous but for the base.* **Fruits:** pedicels *c.* 2 mm long; *calyx lobes unequal*, *3 longer lobes lorate-spatulate*, *to 20 × 2.5 cm*, *tapering to 11 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 8 × 0.4 cm*, *similar at base.* **Nuts** ovoid, to 2.5 × 2 cm, often with persistent filiform style remnant.

Vernacular names. Sabah—*kawang daun merah* (Malay), *seraya lupa* (preferred name). Sarawak—*meranti kawang pinang* (preferred name).

Distribution. Endemic in Borneo.

Ecology. Scattered in mixed and upper dipterocarp forest, particularly on hillsides, at altitudes to 1300 m.

Notes. Three subspecies, *viz.* subsp. *albifolia*, subsp. *nebulosa* and subsp. *parvistipulata*, are recognised, all occurring in Sabah and Sarawak.

Key to subspecies

1. Leaf blade silvery pink lepidote below………………………………………………...

    subsp. **albifolia** P.S.Ashton

    (Latin, *albus* = white, folium = leaf; the silvery pink leaf undersurface)

    Gard. Bull. Sing. 31 (1978) 46. Type: *Wright S 29276*, Borneo, Sarawak, Niah, Sg. Sekaloh (holotype K; isotype KEP).

    Occur in widely separated localities from Niah, NE Sarawak (e.g., the type), to Brunei (e.g., *BRUN 5630*, *S 1689* and *S 1692*) and SE and W Kalimantan (e.g., *bb. 30193*, *bb. 34918* and *Latupeirissa 95003*). Locally common on periodically flooded alluvium, and adjacent moist hillsides, on silty clay soil. Vulnerable owing to suitability of its habitat for agriculture.

   Leaf blade persistently pale yellowish to greyish brown scabrid-pubescent on the veins below……………………………………………………………………………………2

Tree at most 45 m tall, 1.2 m diameter. Leaf blade to 13 × 6 cm; lateral veins to 15 pairs. Larger fruit calyx lobes to 9 × 1.8 cm……………………………………………...

    subsp. **nebulosa** (Meijer) P.S.Ashton

    (Latin, *nebulosus* = clouded with unevenly blended colours: the difficulty of identification)

    Gard. Bull. Sing. 31 (1978) 46; Newman *et al. op. cit.* (1996) 187. Basionym: *Shorea nebulosa* Meijer *op. cit.* 337; Meijer & Wood *op. cit.* 123; Burgess *op. cit.* 183. Lectotype (Ashton, 1978): *G.H.S. Wood & Charrington SAN 16355*, Borneo, Sabah, Ranau district, Poring (hololectotype L).

    Endemic in Borneo; recorded from Ranau, Sipitang, Tambunan, and Tawau districts in Sabah (e.g., *SAN 16273*, *SAN 16357*, *SAN 16435*, *SAN 16769*, *SAN 17010*, and *SAN 31438*).

    Locally frequent in upper dipterocarp forest, at 800–1300 m altitude. Occurring in Kinabalu NP; elsewhere vulnerable.

   Tree to 70 m tall, 2 m diameter. Leaf blade 6–20 × 3–9 cm; lateral veins 13–21 pairs. Larger fruit calyx lobes to 20 × 2.5 cm………………………………………………...

    subsp. **parvistipulata**

    Occurring throughout Borneo, except SW Kalimantan. In Sabah recorded from Beluran, Beaufort, Kota Belud, Kota Merudu, Kudat, Sipitang, Tawau, and Tenom districts (e.g., *SAN 15108*, *SAN 17180*, *SAN 25601*, *SAN 43043*, and *SAN 99603*) and in Sarawak from Bau, Belaga, Kapit, Kuching, Lawas, Limbang, Lundu, Marudi, Miri, and Tatau districts (e.g., *S 15388*, *S 27550*, *SAN 29596*, *S 32376*, and *S 49961*). Also occurring in Brunei (e.g., *BRUN 2005* and *BRUN 3382*) and E, C and W Kalimantan (e.g., *Ambriansyah & Arifin Berau 1045*, *bb. 29625*, *bb. 35337*, *Church et al. 1660*, and *Laman et al. TL 1138*). Scattered in mixed dipterocarp forest on clay soils, particular on hillsides, most common on intermediate and basic igneous rocks and porphyry dikes near limestone hills, at altitudes to 1200 m. Occurring in G. Gading and Mulu NPs; not vulnerable.

92. **Shorea patoiensis** P.S.Ashton

(of Bt. Patoi, Brunei)

(sect. **Richetioides** subsect. **Richetioides**, yellow meranti)

Gard. Bull. Sing. 19 (1962) 302, *op. cit.* (1964) 159, *op. cit.* (1968) 88, *op. cit.* (1982) 476; Meijer & Wood *op. cit.* 78; Burgess *op. cit.* 218; Anderson *op. cit.* (1980) 123; Kessler & Sidiyasa *op. cit.* 109; Coode *et al.* (eds.) *op. cit.* 81; Newman *et al. op. cit.* (1996) 188. **Type:** *Ashton BRUN 3324*, Borneo, Brunei, Bt. Patoi (holotype K; isotype KEP).

Main canopy or low emergent tree, to 45 m tall, to 1 m diameter; crown hemispherical; bole straight, cylindrical; buttresses to 2 m tall but usually less, somewhat slender. **Bark** tawny brown, oblong flaky. *Inflorescence and parts of perianth exposed in bud shortly densely greyish puberulent*; *ovary and stylopodium cream puberulent*; *nut glabrescent*; *vegetative parts glabrous but for fimbriate bud scales and stipules*, *and more or less waxy pruinose young buds and twigs* (mature trees). **Twigs** terete, smooth or rugulose, much-branched, very slender, *c.* 1 mm diameter apically. Leaf buds narrowly ovoid, *c.* 3 × 1 mm (to 4 × 2 mm in juveniles), with the bud scales typically somewhat patent. **Stipules** oblong, acute, *c.* 8 × 2 mm. **Leaves** *more or less chartaceous*, *drying greyish green and curling*; *blade ovate*, *5–8 × 2–3.5 cm*, *base cuneate*, *decurrent for c. 1 mm along the petiole*, *apex with slender acumen to 1 cm long*; *midrib evident*, *flat or sightly elevated within a shallow groove above*, *elevated but not prominent below*; *lateral veins 7–9 pairs*, *slender*, *elevated above*, *more so below*, *arched*; *intercostal venation subscalariform*, *hardly elevated*; *petiole 0.7–1 cm long.* **Inflorescences** terminal or axillary; rachis very slender, terete, to 9 mm diameter, branchlets bearing to 6 secund flowers; bracteoles minute, fugaceous. **Flowers:** buds small, to 3.5 × 1.5 mm; corolla lemon yellow; *stamens 15*, *connectival appendage equal to anther*, *ciliate towards apex*; *ovary ovoid*, *with cylindrical stylopodium*, *style short*, *glabrous.* **Fruits:** *calyx lobes subequal*, *shorter than nut*, *lobes broadly ovate*, *to 0.5 × 0.5 cm*, *appressed to nut and united into a 0.5–0.9 × 0.4–0.5 cm receptacle at base.* **Nuts** oblong-ellipsoid, to 1.8 × 1 cm, with minute style remnant, subglabrous, striated.

Vernacular name. Sarawak—*lun hitam padi* (preferred name).

Distribution. Endemic in Borneo. Known in Sabah from Beaufort, Lahad Datu, Sandakan, and Tawau districts (e.g., *SAN 16462*, *SAN 21498*, *SAN 23556*, *SAN 31475*, and *SAN 63055*) and in Sarawak from Belaga, Bintulu, Kapit, Limbang, Miri and Tatau districts (e.g., *S 15141*, *S 22477*, *S 29678*, *S 43644*, and *S 68918*). Also occurring in Brunei (e.g., *BRUN 3324*, *BRUN 5710*, *BRUN 5811*, and *Johns 7474*) and E Kalimantan (e.g., *Ambriansyah Berau 885*, *bb. 18967* and *Kostermans 13850*).

Ecology. Frequent on moist well-structured clay soils, especially on hill sides, over shale and especially basic volcanic rocks; abundant for instance on the Bt. Mersing, Sarawak, basalt; also on the Hose Mountain and Usun Apau dacite. Common in Lambir and Mulu NPs; probably not vulnerable.

93. **Shorea pauciflora** King

(Latin, *paucus* = few, *flos* = flower; a supposed few-flowered inflorescence)

(sect. **Brachypterae**, red meranti)

J. As. Soc. Beng. 62, 2, (1893) 116; Merrill *op. cit.* (1929) 203; Keith *op. cit.* 25; Masamune *op. cit.* 496; Symington *op. cit.* (1943) 87; Browne *op. cit.* 149; Ashton *op. cit.* (1964) 207, *op. cit.* (1968) 114, *op. cit.* (1978) 47, *op. cit.* (1982) 511; Meijer & Wood *op. cit.* 133; Burgess *op. cit.* 165; Anderson *op. cit.* (1980) 128; PROSEA *op. cit.* 400; Kessler &. Sidiyasa *op. cit.* 109; Coode *et al.* (eds.) *op. cit.* 114; Newman *et al. op. cit.* (1996) 189. **Type:** *Curtis 1537*, Peninsular Malaysia, Penang Hill (holotype CAL; isotype K).

Huge emergent tree, to 60 m tall, to 2.2 m diameter; crown eventually immense, cauliflower-shaped; bole straight, tall, cylindrical; buttresses to 4 m tall, stout. **Bark** dark purplish brown eventually fawn-brown, shallowly densely cracked becoming thinly oblong flaky, flakes at first persisting and curling up, surface overall eventually appearing rather smooth; dammar smears greyish brown; inner bark meat-red; heartwood dark reddish brown. *Leaf bud*, *parts of perianth exposed in bud*, *inflorescence*, *stipule*, *and bracteole persistently evenly golden brown pubescent*; *venation below*, *petiole*, *fruit calyx*, *and young twig sparsely caducously so*; *ovary and nut buff pubescent.* **Twigs** terete, 1.5–2.5 mm diameter apically, becoming flaky; stipule scars pale, short, horizontal. Leaf buds ovoid, acute, 4–8 × 2–3.5 mm. **Stipules** hastate, to 13 × 4 mm. **Leaves** *thinly coriaceous*, *drying brick-red or purplish brown below*; *blade ovate*, *9–15 × 4–5.5 cm*, *base frequently subequal*, *obtuse to broadly cuneate*, *apex with slender acumen 0.6–1.2 cm long*; *midrib obscurely sunken above*, *prominent below*; *lateral veins 8–9 pairs*, *slender but prominent below*, *generally drying paler than blade*, *ascending and arched*, *sometimes with small pore-like domatia*; *intercostal venation densely scalariform*, *very slender*, *hardly raised*; *petiole 1.3–1.8 cm long.* **Inflorescences** terminal or axillary; rachis ribbed or slightly compressed, lax, to 15 cm long, to trebly branched, branchlets bearing to 20 secund flowers; bracteoles oblong, subacute, to 4 × 2.5 mm. **Flowers:** *petals pale yellow*; *stamens 15*, *connectival appendage c. 2x the length of anther*, *sericeous distally*; *ovary and stylopodium ovoid-conical*, *style slightly shorter than both*, *glabrous.* **Fruits:** *calyx lobes unequal*, *3 longer lobes to 9 × 1.5 cm*, *tapering to c. 4 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 5 × 0.5 cm*, *similar at base.* **Nuts** broadly ovoid, *c.* 1.4 × 1.2 cm, with short apical style remnant.

Vernacular names. Sabah—*oba suluk* (preferred name). Sarawak—*nemesu* (preferred name), *perawan samak* (Iban).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo widespread, recorded in Sabah from Beaufort, Kinabatangan, Kuala Penyu, Lahad Datu, Sandakan, Sipitang, Tawau, and Tenom districts (e.g., *SAN 15082*, *SAN 16587*, *SAN 17773*, *SAN 27362*, and *SAN 134945*) and in Sarawak from Bau, Belaga, Bintulu, Kapit, Kuching, Lundu, Samarahan, and Sri Aman districts (e.g., *S 10183*, *S 22884*, *S 29242*, *S 36907*, *S 68724*). Also occurring in Brunei (e.g., *BRUN 3374* and *BRUN 5085*) and Kalimantan (e.g., *bb. 34256* and *Kostermans 6042*).

Ecology. Ubiquitous, locally common, usually as scattered trees, in mixed dipterocarp forest on yellow-red sandy, sandy clay and clay soils, including on the plateau sandstone and granodiorite of W Sarawak, the Arip rhyolite, and the inland sedimentaries. One of our most widespread dipterocarps. Occurring in Bako, G. Gading, Kinabalu, Kubah, Lambir, and Mulu NPs, and Danum Valley Conservation Area and Sepilok FR; not vulnerable.

94. **Shorea peltata** Symington

(Latin, *peltatus* = shield-shaped, the leaf)

(sect. **Richetioides**, subsection **Richetioides**, yellow meranti)

J. Malay. Br. Roy. As. Soc. 19 (1941) 158, *op. cit* (1943) 56; Slooten *op. cit.* (1956) 337; Ashton *op. cit.* (1982) 473. **Type:** *Abdul Jaffar KEP 49356*, Peninsular Malaysia, Johor, Jemaluang FR (holotype KEP).

Subcanopy or canopy hardly buttressed tree, to 40 m tall, 30 cm diameter. **Bark** smooth or shallowly nobbly. *Inflorescences petals outside and nut persistently densely buff pubescent*, *caducous on calyx outside*; *parts otherwise glabrescent.* **Twigs** terete, smooth, *c.* 2 mm diameter apically. Leaf buds ovoid-acute, minute. **Stipules** unknown. **Leaves** *deeply peltate*, *chartaceous to thinly coriaceous*; *blade oblong*, *8–16 × 4–7.5 cm*, apex with acumen to 1 cm long; midrib evident but slightly furrowed above, raised below; *lateral veins 8–9 pairs*, *the first 3 of which opposite and radiating from the petiole insertion*; intercostal venation subreticulate, elevated on both surfaces; petiole 1.8–3 cm long, slender. **Inflorescence** terminal or axillary; branchlets to 1 cm long bearing to 5 flowers. **Flower:** buds lanceolate, to 6 mm long; stamens 15, in 3 whorls, connectival appendage *c.* 1½x the length of anther, slender, scabrous distally; ovary ovoid sericeous distally, without stylopodium, style glabrous, columnar, equal to ovary. **Fruits:** subsessile; calyx lobes short, subequal, ovate, tuberculate-incrassate, to 1 × 0.8 cm. **Nuts** obovoid, to 3 × 2 cm, subacute.

Vernacular name. Sabah—*seraya kuning keladi* (preferred name).

Distribution. Sumatra, Peninsular Malaysia (SE Johore) and Borneo. In Borneo known only from Labuk Sugut district, E Sabah (e.g., *SAN 70329* and *SAN 131964*).

Ecology. Very local, in mixed lowland dipterocarp forerst on leached clay soil. Critically endangered.

95. **Shorea pilosa** P.S.Ashton

(Latin, *pilosus* = long hairy; the indumentum)

(sect. **Pachycarpae**, red meranti)

Gard. Bull. Sing. 19 (1962) 304, *op. cit.* (1964) 209, *op. cit.* (1968) 115, *op. cit.* (1982) 521; Meijer & Wood *op. cit.* 136; Burgess *op. cit.* 183; Anderson *op. cit.* (1980) 128; Coode *et al.* (eds.) *op. cit.* 81; Newman *et al. op. cit.* (1996) 191. **Type:** *G.H.S. Wood SAN 16721*, Borneo, Sabah, Sipitang district, Ulu Mendalong (holotype K; isotypes KEP, L).

Medium-sized emergent tree, to 45 m tall, to 1.3 m diameter; crown golden suffused from below, dense, hemispherical; bole straight, cylindrical; buttresses occasionally to 4 m tall, stout. **Bark** pale yellowish brown, smooth, hoop-marked, eventually patchily cracked, flaking leaving scroll-marked surfaces; inner bark pale coffee-coloured; heartwood pale pink, fairly soft. *Twig*, *leaf bud*, *inflorescence*, *parts of calyx exposed in bud*, *petiole*, *midrib on both surfaces*, *and blade below persistently golden scabrid-tomentose*; *blade above and fruit calyx sparsely pubescent*, *glabrescent*; *part of corolla exposed in bud and nut evenly buff pubescent.* **Twigs** slightly compressed at apex, much-branched, 2–2.5 mm diameter apically. Leaf buds ovoid, 3–7 × 1.5–3 mm. **Stipules** hastate, to 35 × 15 mm. **Leaves** *thinly coriaceous*, *drying golden-tawny below*, *pinkish brown above*; *blade ovate-elliptic*, *10–17 × 4–7.5 cm*, *base obtuse*, *margin usually narrowly revolute*, *apex with slender acumen to 1.3 cm long*; *midrib evident*, *slender but furrowed above*, *prominent below*; *lateral veins 12–15 pairs*, *arched*, *dense*, *with prominent axillary tufted tomentose domatia*; *intercostal venation densely scalariform with reticulate finer veins*, *minutely raised below*; *petiole 1–1.3 cm long.* **Inflorescences** terminal or axillary, singly branched; rachis terete, to 14 cm long. **Flowers:** buds to 8 × 3 mm; petals cream suffused with pink; stamens 15, connectival appendage *c.* 4x as long as anther; ovary ovoid, glabrous, style and stylopodium spindle-shaped. **Fruits:** *calyx lobes unequal*, *3 longer lobes to 17 × 2.5 cm*, *tapering to c. 13 mm above the saccate base*, *2 shorter ones to 12 × 1 cm*, *otherwise similar*. **Nuts** ovoid, to 2 × 1.8 cm, with short acute style remnant.

Vernacular names. Sabah—*kawang bulu* (preferred name). Sarawak—*kawang bulu* (Iban), *meranti bulu* (Malay).

Distribution. Endemic in Borneo. In Sabah known from Beaufort, Sipitang, Tawau, and Tenom districts (e.g., *SAN 24808*, *SAN 35890* and *SAN A 1748*) and in Sarawak from Bintulu, Kapit, Lawas, Miri, and Tatau districts (e.g., *S 1752*, *S 17792*, *S 18429*, *S 22235*, and *S 25018*). Also occurring in Brunei (e.g., *BRUN 2636* and *S 5777*).

Ecology. Rare, local, in mixed dipterocarp forest on lowers slopes and undulating land, on sandy clay and well-structured clay soils, including the Bt. Mersing, Anap basalt. Occurring in Lambir and Mulu NPs; elsewhere vulnerable owing to land conversion.

96. **Shorea pinanga** Scheff.

(from an indigenous name—*pinang*)

(sect. **Pachycarpae**, red meranti)

Nat. Tijd. Ned. Ind. 31 (1870) 350; Beccari *op. cit.* 570; Merrill *op. cit.* (1921) 406, *op. cit.* (1929) 203; Masamune *op. cit.* 496; Ashton *op. cit.* (1963) 281, *op. cit.* (1964) 210, *op. cit.* (1968) 115, *op. cit.* (1982) 526; Meijer & Wood *op. cit.* 137; Burgess *op. cit.* 182; Anderson *op. cit.* (1980) 128; PROSEA *op. cit.* 400; Kessler & Sidiyasa *op. cit.* 109; Coode *et al.* (eds.) *op. cit.* 81; Newman *et al. op. cit.* (1996) 192. **Lectotype** (designated here)**:** *s.c. s.n.*, cult. in Hort. Bogor (hololectotype BO; isolectotypes L, U). **Synonyms:** *Shorea gysbertsiana* Burck var. *scabra* Burck *op. cit.* (1886) 17, *p.p.*; *S. compressa* Burck *op. cit.* (1886) 26.

Medium-sized emergent tree, to 45 m tall, to 1.3 m diameter; bole straight, cylindrical; crown loosely dome-shaped to oblong, the branch endings pendent; buttresses to 1.5 m tall, stout. **Bark** pale pinkish brown, smooth, hoop-marked, eventually becoming patchily cracked and irregularly flaked; inner bark pale pinkish brown; heartwood pale pink, relatively soft. *Young twig*, *inflorescence*, *leaf bud*, *parts of calyx exposed in bud*, *stipule*, *bracteole*, *petiole and sometimes blade below glabrous or fugaceously to persistently golden brown pubescent*; *nut yellowish buff pubescent*. **Twigs** *compressed*, *4–6 × 2–3 mm apically*; *stipule scars prominent*, *falcate*, *descending*. Leaf buds hastate, subacute, usually hidden in subpersistent stipules, to 10 × 4 mm. **Stipules** *hastate*, *to 10 × 4 mm*, *subpersistent*. **Leaves** *thinly coriaceous*, *drying shiny coppery brown below* (unless tomentose); *blade elliptic to narrowly ovate*, *11–24 × 4–9 cm*, *base broadly cuneate to subcordate*, *apex with tapering acumen to 1.5 cm long*; *midrib slender but evident*, *flat or shallowly furrowed above*, *prominent below*; *lateral veins 10–20 pairs*, *slender but raised below*, *arched*; *intercostal venation densely scalariform*, *hardly raised*; *petiole 1.5–2.3 cm long*, *slender*. **Inflorescences** terminal or axillary; rachis lax, compressed, to 24 cm long, singly branched, branchlets bearing to 15 flowers; bracteoles broadly ovate, to 10 × 8 mm, subpersistent. **Flowers:** petals deep pink; stamens 15, connectival appendage many times longer than anther; *ovary ovoid*, *stylopodium obscure*, *style twice the length of ovary*, *columnar*. **Fruits:** *calyx lobes unequal*, *3 longer lobes coriaceous*, *to 23 × 3.5 cm*, *tapering to c. 13 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 17 × 1.2 cm*, *similar at base*. **Nuts** broadly ovoid, to 2.3 × 2.3 cm, with 2 mm slender style remnant.

Vernacular names. Sabah—*kawang pinang* (preferred name). Sarawak—*engkabang langgai bukit* (Iban), *meranti langgai bukit* (preferred name).

Distribution. Endemic in Borneo, occurring throughout the island. In Sabah recorded from Beaufort, Keningau, Kinabatangan, Labuk Sugut, Ranau, Sandakan, Sipitang, and Tawau districts (e.g., *SAN 15260*, *SAN 18601*, *SAN 36509*, *SAN 39168*, and *SAN 99370*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lawas, Limbang, Miri, Samarahan, Serian, and Sibu districts (e.g., *S 14740*, *S 16429*, *S 22250*, *S 29060*, and *S 43616*). Also occurring in Brunei (e.g., *BRUN 3344* and *FMS 35682*), and throughout Kalimantan (e.g., *bb. 29665*, *Kessler et al. Berau 704* and *Meijer 2206*).

Ecology. Locally common, in mixed dipterocarp forest on leached clay and sandy clay soils, especially on ridges and low hills. Occurring in Mulu NP; probably not vulnerable.

Notes. A variable species, distinguished by its falcate stipule scar, many slender veins and very long fruit sepals. Typically, the vegetative parts are glabrous but one form, with stout twig and larger than normal leaf, is pubescent on twig and leaf below; in E Sabah the leaf is very large, with markedly cuneate base, and shares characteristics with *S. macrophylla* (see there).

97. **Shorea platycarpa** F.Heim

(Greek, *platy-* = flat, *karpos* = fruit; perhaps referring to the fruit calyx)

(sect. **Mutica** subsect. **Mutica**, red meranti)

Bull. Mens. Soc. Linn. Paris 2 (1891) 956; Beccari *op. cit.* 510; Merrill *op. cit.* (1921) 406; Symington *op. cit.* (1933) 133, *op. cit.* (1943) 88; Masamune *op. cit.* 496; Browne *op. cit.* 142; Anderson *op. cit.* (1963) 159, *op. cit.* (1980) 128; Ashton *op. cit.* (1964) 211, *op. cit.* (1968) 115, *op. cit.* (1982) 541; Meijer & Wood *op. cit.* 138; Burgess *op. cit.* 154; PROSEA *op. cit.* 400; Coode *et al.* (eds.) *op. cit.* 81; Newman *et al. op. cit.* (1998) 194. **Type:** *Beccari PB 3302*, Borneo, Sarawak, Marop (holotype P). **Synonym:** *Shorea palustris* Ridl., *op. cit.* (1922) 224.

Emergent tree, to 50 m tall, to 1.2 m diameter; bole tall, straight; crown shallowly hemispherical, diffuse; buttresses to 4 m tall, stout. **Bark** greyish to pinkish brown, becoming deeply v-section fissured, eventually crumbly flaky; inner bark dull pinkish brown; heartwood pale reddish brown, relatively soft; dammar as pale yellowish cream smears. *Young twig*, *inflorescence*, *leaf bud*, *parts of calyx exposed in bud*, *and petiole densely persistently rust-brown scabrid pubescent*; *sparsely so on stipule*, *bracteole*, *midrib above and blade below*, *and base of fruit calyx*; *glabrescent on blade above*; *petals outside and nut densely buff pubescent*. **Twigs** ridged, verrucose, stout, *c.* 3 mm diameter apically. Leaf buds broadly ovoid, obtuse, 4–6 × 3.5–5 mm. **Stipules** ovate, subacute, to 10 × 6 mm. **Leaves** *thinly coriaceous*, *drying reddish brown*; *blade elliptic-oblong to broadly ovate*, *9–17 × 5.5–10 cm*, *base obtuse*, *apex with broad acumen to 1 cm long*; *midrib slender*, *more or less flat above*, *prominent below*, *in juveniles furnished with pale scale-like domatia along part of its length from the base*; *lateral veins 16–20 pairs*, *dense*, *straight until approaching margin*, *slender but prominent*, *in juveniles with scale-like domatia*; *intercostal venation laxly scalariform*, *slender but distinctly elevated*; *petiole 1.5–2 cm long*, *stout.* **Inflorescences** terminal or axillary; rachis rigid, ribbed, to 9 cm long; bracteoles broadly ovate, acute, to 4 × 3 mm. **Flowers:** *petals pale yellow*; stamens 15, connectival appendage as long as anther, becoming reflexed; ovary and stylopodium narrowly ovoid, subglabrous, style as long as both, filiform, glabrous. **Fruits** subsessile; *calyx lobes unequal*, *3 longer lobes chartaceous*, *to 6.5 × 1.2 cm*, *tapering to 4 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 2 cm long*, *similar at base*. **Nuts** ovoid, to 0.8 × 0.6 cm, acute.

Vernacular name. Sarawak—*meranti paya* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah known only from Sipitang district (e.g., *SAN 19001*, *SAN 27966* and *SAN 130246*) and in Sarawak from Bintulu, Daro, Kuching, Sibu, Simunjan, and Sri Aman districts (e.g., *S 261*, *S 452*, *S 7273*, *S 12853*, and *S 13501*). Also occurring in Brunei (e.g., *BRUN 371* and *FMS 28695*) and Kalimantan.

Ecology. Locally common, widespread, in mixed peat swamp forest, especially near the coast, and on poorly drained podsols on the former beach terraces on the lower Medamit, Ulu Limbang, Sarawak. Recorded from Mulu NP; elsewhere endangered by forest conversion.

98. **Shorea platyclados** Slooten *ex* Foxw.

(Greek, *platy-* = flat, *clados* = a shoot; the compressed twigs)

(sect. **Brachypterae**, red meranti)

Malay. For Rec. 10 (1932) 214; Symington, J. Malay. Br. Roy. As. Soc. 14 (1936) 336, *op. cit.* (1939) 377, *op. cit.* (1943) 89; Slooten Bull. Jard. Bot. Buitenz. 3, 16 (1941) 110; Masamune *op. cit.* 496; Ashton *op. cit.* (1964) 212, *op. cit.* (1968) 115, *op. cit.* (1982) 515; Meijer & Wood *op. cit.* 139; Burgess *op. cit.* 166; Anderson *op. cit.* (1980) 129; PROSEA *op. cit.* 401; Coode *et al*. (eds.) *op. cit.* 81; Newman *et al*. *op. cit.* (1996) 195. **Type:** *Symington KEP 24416*, Peninsular Malaysia, Selangor, Ulu Gombak (holotype KEP).

Large emergent tree, to 50 m tall, to 1.8 m diameter; bole tall, cylindrical, but also often a small gnarled main canopy tree; crown large, hemispherical, eventually diffuse; buttresses to 4 m tall, stout,. **Bark** dark warm chocolate-brown, deeply narrowly fissured and flaking; dammar incrustations pale yellow, conspicuous on bole; inner bark reddish brown to yellowish brown within; heartwood deep crimson red. *Young parts pale grey sericeous, fugaceous except on stipule, bracteole and panicle.* **Twigs** *compressed, glabrous, smooth, c. 3 × 1.5 mm apically.* Leaf buds compressed, falcate, to 4 × 1.5 mm. **Stipules** hastate, to 13 × 3.5 mm. **Leaves** *remaining distichous, thinly coraceous, satiny, drying dark chocolate-brown below; blade lanceolate, 6–9 × 2–3 cm, base cuneate owing to the revolute basal margin, margin undulate, apex with slender acumen c. 1 cm long; midrib obscurely sunken above, acute and sharply prominent below; lateral veins 15–18 pairs, very slender, hardly elevated below, ascending, with short intermediate veins; intercostal venation densely scalariform, very slender; petiole slender, laterally compressed, 1–1.5 cm long.* **Inflorescences** terminal or axillary; rachis compressed, slender, to 7 cm long, singly branched, branchlets bearing to 7 flowers; bracteoles to 4 × 2 mm, elliptic, fugaceous. **Flowers:** petals pale yellow; *stamens 15, connectival appendage c. 4x the length of anther, glabrous; ovary and stylopodium pyriform, sericeous towards apex, style as long as both, glabrous.* **Fruits:** *calyx lobes unequal, 3 longer lobes to 10 × 1 cm, tapering to 4 mm above the saccate base, 2 shorter ones linear-lobed, to 5 × 0.4 cm, similar at base.* **Nuts** ovoid, to 1.5 × 1 cm, acute, *glabrescent.*

Vernacular names. Sabah—*seraya bukit* (preferred name). Sarawak—*meranti bukit* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. Throughout the mountain system of Sabah and Sarawak, wherever the habitat occurs. In Sabah recorded from Keningau, Ranau, Sipitang, and Tambunan districts (e.g., *SAN 16581*, *SAN 17026*, *SAN 22091*, *SAN 69102*, and *SAN 132706*) and in Sarawak from Kapit, Lawas and Limbang districts (e.g., *S 12108*, *S 17754*, *S 22212*, *S 26549*, and *S 33073*). Also occurring in Brunei (e.g., *BRUN 410* and *BRUN 2541*) and SE and W Kalimantan (e.g., *bb. 20666*, *bb. 30194* and *Endert 3691*).

Ecology. Locally common in upper dipterocarp forest, at 700–1300 m altitude, but only on deep friable red-brown fertile clay soils; on shale and basalt. Occasional on similar soils in valleys at the base of the mountains, at altitudes as low as 150 m. Occurring in Kinabalu and Mulu NPs; elsewhere vulnerable owing to logging.

99. **Shorea polyandra** P.S.Ashton

(Greek, *poly-* = many, *andra* = males; the many stamens)

(sect. **Richetioides**, subsect. **Polyandrae**, yellow meranti)

Gard. Bull. Sing. 22 (1967) 286, *op. cit.* (1968) 88, *op. cit.* (1982) 470; Anderson *op. cit.* (1980) 123; PROSEA *op. cit.* 420; Newman *et al. op. cit.* (1996) 196. **Type:** *Bojeng S 10171*, Borneo, Sarawak, Lundu district, G. Gading FR (holotype K; isotype KEP).

Vast emergent tree, to 70 m tall, to 2 m diameter, with tall somewhat tapering bole and immense cauliflower-shaped crown pale from below; buttresses to 4 m tall, prominent, somewhat stout. **Bark** becoming chocolate-brown, deeply cracked and thickly oblong-flaky; inner bark purplish brown, laminated. *Twig, petiole and blade below persistently purplish rufous lepidote fading to grey* (mature trees); *leaf bud, stipule, inflorescence, parts of perianth exposed in bud, bracteole, ovary, style, and nut persistently shortly purplish-rufous pubescent; fruit calyx sparsely so towards base, glabrescent.* **Twigs** terete, smooth or rugulose-striated, slender, *c.* 1 mm diameter apically. Leaf buds ellipsoid, to 2 × 1 mm, acute. **Stipules** lanceolate, to 5 × 2 mm, fugaceous. **Leaves** *chartaceous, undulate, drying* *purplish brown with the venation darker and curling*; *blade lanceolate*, *8–13 × 3–5 cm*, *base cuneate*, *margin minutely revolute*, *apex with slender acumen to 2 cm long*; *midrib and veins narrowly sunken and obscure above*, *slender but distinctly raised below*; *lateral veins 11–14 pairs*, *arched*, *ascending*; *intercostal venation laxly scalariform*, *slender*, *more or less obscure below*; *petiole 1.4–2 cm long*, *slender*. **Inflorescences** terminal or axillary; rachis terete, to 6 cm long, singly branched, branchlets bearing to 3 flowers; bracteoles elliptic, subacute, to 4 × 3 mm, caducous. **Flowers:** *buds broadly ovoid*, *to 5 × 4 mm*; *petals oblong*, *obtuse*; *stamens 102–107*, *anthers narrowly oblong*, *length c. 4x breadth*, *connectival appendage stout but filiform*, *tapering*, *somewhat shorter in length than anther*, *densely ciliate apically*, *not reflexed*; *ovary ovoid*, *without stylopodium*, *surmounted by a short broadly columnar trifid style*. **Fruits:** pedicels *c.* 1 mm long; *calyx lobes unequal*, *3 longer lobes to 8 × 1.4 cm*, *tapering to 8 mm above the saccate tuberculate base*, *2 shorter ones linear-lobed*, *to 5 × 0.5 cm*, *similar at base*. **Nuts** narrowly ovoid, to 3 × 1.3 cm, acute.

Vernacular name. Sabah—*seraya kuning Quoin* (preferred name).

Distribution. Endemic in Borneo. In Sabah recorded from Tawau district (e.g., *SAN 15265*, *SAN 16478*, *SAN 63027*, *SAN A 3465*, and *SAN A 3959*) and in Sarawak from Lundu and Miri districts (e.g., *S 7979*, *S 10174*, *S 10189*, *S 25298*, and *S 75394*). Also occurring in SE Kalimantan (e.g., *bb. 23349* and *Kostermans 13302*).

Ecology. In clusters of immense trees, on well-structured and well-watered fertile clay loams overlying calcareous shale, basic volcanic rock and granodiorite. Well represented in G. Gading NP and occurring in Lambir NP; elsewhere endangered by land conversion.

100. **Shorea praestans** P.S.Ashton

(Latin, *praestans* = preeminent; the striking stipules and leaf shape)

(sect. **Pachycarpae**, red meranti)

Gard. Bull. Sing. 22 (1967) 297, *op. cit.* (1968) 115, *op. cit.* (1982) 524; Anderson *op. cit.* (1980) 129; Newman *et al. op. cit.* (1996) 198. **Type:** *Brunig s.n.*, Borneo, Sarawak, Bintulu district, Nyabau FR (holotype K).

Subcanopy, possibly canopy tree, to 30 m tall, to 15 cm diameter. **Bark** smooth, hoop-marked, ochreous-brown and grey-mottled; inner bark pinkish brown. *All observed parts glabrous*. **Twigs** compressed, smooth, stout, *c.* 5 × 3 mm apically. Leaf buds falcate-lanceolate, to 25 × 7 mm. **Stipules** *elliptic*, *subacute*, *very large*, *to 110 × 50 mm*, *not at first caducous*. **Leaves** *thickly coriaceous*, *drying greyish brown above*, *reddish brown shiny below*; *blade broadly oblong*, *24–35 × 11–18 cm*, *base cordate*, *apex obtuse to shortly broadly acuminate*; *midrib broad but flat above*, *prominent below*; *lateral veins 11–13 pairs*, *prominent below*; *intercostal venation remotely subscalariform*, *slightly elevated below*; *petiole stout*, *weakly geniculate*, *4–6.5 cm long*. **Inflorescences** and **flowers** unknown. **Fruits:** *pedicels to 5 mm long and stout*; *calyx lobes unequal*, *3 longer lobes to 15 × 3 cm*, *tapering to c. 1.5 cm above the saccate base*, *2 shorter ones to 10.5 × 1.5 cm*, *similar at base*. **Nuts** ovoid, to 2 × 2 cm, glabrous, with to 4 mm long style remnant.

Distribution. Endemic in Borneo (C Sarawak); known from Bintulu and Mukah districts (e.g., *S 19598*, *S 22074*, *S 22075*, and *S 37863*).

Ecology. Rare and confined to deep yellow sandy soil on low hills of Neogene sandstone, in mixed dipterocarp forest; as scattered trees or small groups. Possibly extinct, otherwise critically endangered.

Notes. Central Sarawak has other distinctive, apparently small, trees representing undescribed entities in sect. *Pachycarpae*, the main section of red merantis yielding illipe (*engkabang*, *kawang*, *tengkawang*) nuts. As such they represent important genetic resources; yet all appear to be rare, and under present wide forest conversion gravely threatened with extinction. None have been sufficiently collected in flower or fruit for scientific description. One other such species is '63. *Shorea* sp.' (Ashton *op. cit.* (1968) 122), from Pelagus rapids and Bt. Alet, Nanga Bah, Kapit district.

101. **Shorea pubistyla** P.S.Ashton

(Latin, *pubi-* = downy, *stylus* = the floral style; the pubescent stylopodium)

(sect. **Brachypterae**, red meranti)

Gard. Bull. Sing. 22 (1967) 297, *op. cit.* (1968) 116, *op. cit.* (1982) 516; Anderson *op. cit.* (1980) 129; Newman *et al. op. cit.* (1996) 198. **Type:** *Anderson S 14930*, Borneo, Sarawak, Kuching district, Semengoh FR (holotype K; isotypes KEP, L).

Large emergent tree, to 50 m tall, to 1.6 m diameter; bole straight, cylindrical; crown loosely hemispherical, with a few large branches, golden suffused from below; buttresses to 1.5 m tall, stout. **Bark** pale chocolate-brown mottled-grey, deeply irregularly fissured and chunkily flaky; dammar as frequent pale yellow incrustations; inner bark dark coffee-coloured; heartwood rich reddish brown. *Twig*, *leaf bud*, *inflorescence*, *parts of calyx exposed in bud*, *petiole*, *and midrib below densely dark fulvous scabrid-tomentose*; *more shortly sparsely so on venation below*, *midrib above*, *and stipule outside*; *stipule within*, *bracteole and fruit calyx densely pale fulvous pubescent*, *caducous on fruit*; *outside of petal*, *ovary*, *stylopodium*, *and nut evenly pale cream-brown pubescent.* **Twigs** prominently ribbed at first, stout, *c.* 7 mm diameter apically. *Leaf buds ovoid*, *compressed*, *to 1.3 × 1.3 mm.* **Stipules** lanceolate, to 25 × 7 mm, caducous. **Leaves** *thickly coriaceous*, *drying warm chocolate-brown below*; *blade broadly oblong to obovate*, *11–19 × 7–12 cm*, *base obtuse to cordate*, *margin shallowly subrevolute*, *apex retuse*, *obtuse or shortly acuminate*; *midrib slender and more or less evident*, *furrowed above*, *prominent below*; *lateral veins 14–18 pairs*, *stoutly prominent below*, *obscurely sunken above*; *intercostal venation remotely scalariform*; *petiole 2.5–4 cm long*, *stout*, *weakly geniculate.* **Inflorescences** axillary, stout; rachis ribbed, lax, to 20 cm long, singly branched, branchlets bearing to 12 flowers; bracteoles oblong-ovate, subacute, to 8 × 5 mm, fugaceous. **Flowers:** *petals pink outside*, *crimson within*; *stamens 15*, *connectival appendage 2–3x as long as anther*, *glabrous*; *ovary ovoid*, *crowned by a slightly longer cylindrical stylopodium and short glabrous style.* **Fruits:** *pedicels to 3 mm long and diameter*, *stout*; *calyx lobes unequal*, *3 longer lobes to 14 × 2.5 cm*, *tapering to c. 8 mm above the saccate base*, *2 shorter ones lorate-lobed*, *to 12 × 1.2 cm*, *otherwise similar.* **Nuts** narrowly ovoid, to 3 × 1.8 cm, with to 4 mm long apical tapering stylopodium remnant.

Vernacular name. Sarawak—*meranti bulu merah* (preferred name).

Distribution. Endemic in Borneo (W and C Sarawak and presumably also in the Kapuas valley, W Kalimantan). In Sarawak known from Kuching, Miri and Tatau districts (e.g., *S 16473*, *S 19575*, *S 32422*, *S 42349*, and *S 68407*).

Ecology. Locally frequent, on deep leached yellow sandy clay soils in mixed dipterocarp forest, on low hills, at altitudes to 400 m, generally not far from the coast. Occurring in Lambir NP; elsewhere vulnerable owing to its accessible lowland habitat being liable to land conversion.

102. **Shorea quadrinervis** Slooten

(Latin, *quadri-* = four-, *nervis* = nerved; the four-veined leaf)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

Bull. Jard. Bot. Buitenz. 3, 17 (1942) 220; Browne *op. cit.* 142; Ashton *op. cit.* (1964) 213, *op. cit.* (1968) 116, *op. cit.* (1982) 534; Meijer & Wood *op. cit.* 140; Burgess *op. cit.* 155, 183; Anderson *op. cit.* (1980) 129; PROSEA *op. cit.* 401; Coode *et al.* (eds.) *op. cit.* 82; Newman *et al. op. cit.* (1996) 199. **Lectotype** (designated here)**:** *bb. 29450*, Borneo, W Kalimantan, Sambas, Sg. Akar (hololectotype BO).

Medium-sized emergent tree, to 45 m tall, to 1.4 m diameter; bole straight, cylindrical, frequently quite short; crown hemispherical to oblong, the branch endings pendent; buttresses to 2.5 m tall, stout. **Bark** pinkish grey to pale brown, shallowly v-section fissured, eventually deeply so and powdery chunkily flaking; dammar as pale yellow incrustations; inner bark bright crimson, paler at cambium; heartwood pale reddish brown. *Young parts shortly densely tawny pubescent*, *more or less caducous on stipule*, *bracteole*, *leaf bud*, *and blade below*, *becoming sparse on fruit calyx*; *base of midrib above*, *inflorescence*, *parts of perianth exposed in bud*, *ovary*, *and nut persistently so.* **Twigs** *c.* 3 mm diameter apically, terete, stout, strongly ridged below stipule scars, becoming minutely cracked; stipule scars pale, prominent, falcate or descending-amplexicaul. *Leaf buds compressed*, *ovate-subcordate*, to 20 × 13 mm, *loosely enveloped in stipules*. **Stipules** *ovate to subcordate*, *to 25 × 13 mm*, *prominently ridged along their 5 veins*, *pairs sometimes united at base*, *subpersistent*. **Leaves** *strongly concave*, *thinly coriaceous*, *drying warm reddish brown below*; *blade broadly ovate to elliptic*, *10–18 × 5–8 cm*, *base obtuse*, *margin more or less revolute*, *apex with tapering acumen to 1.3 cm long*; *midrib obscure*, *sunken above*, *prominent below*; *lateral veins c. 4 pairs*, *arched*, *ascending*, *prominent below with at least one prominent but shorter intermediate vein*; *intercostal venation slender*, *scalariform*; *petiole 0.8–1 cm long.* **Inflorescences** terminal or axillary; rachis lax, spreading, terete or angular, *to 28 cm long*, *to trebly branched*, branchlets bearing to 6 flowers; *bracts as the stipules*, *caducous.* **Flowers:** petals pink, paler at margins; stamens 15, connectival appendage shorter than anther, reflexed; ovary and stylopodium conical, style short, stigma relatively prominent. **Fruits:** *calyx lobes unequal*, *3 longer lobes to 8 × 1.3 cm*, *tapering to c. 3 mm above the saccate base*, *2 shorter ones to 5.5 × 0.7 cm*, *otherwise similar*. **Nuts** narrowly ovoid, to 1.5 × 0.7 cm, with *c.* 1.5 mm long slender style remnant.

Vernacular names. Sabah—*seraya sudu* (preferred name). Sarawak—*meranti sudu* (preferred name).

Distribution. Endemic in Borneo. Known in Sabah from Beaufort and Sipitang districts (e.g., *SAN 15051*, *SAN 16291*, *SAN 16923*, *SAN 24821*, and *SAN 126703*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Limbang, Lubok Antu, Lundu, Marudi, Miri, and Simunjan districts (e.g., *S 10067*, *S 27135*, *S 32271*, *S 37822*, and *S 69660*). Also occurring in Brunei (e.g., *BRUN 1800* and *BRUN 3066*) and Kalimantan (e.g., *bb. 30222* and *Yamada K 9525*).

Ecology. Common in mixed dipterocarp forest on leached yellow shallowly sandy humic soils in the lowlands, and also on skeletal soils on ridges, at altitude to 700 m. Common in Bako, Kubah, Lambir and Mulu NPs; not vulnerable.

103. **Shorea resinosa** Foxw.

(Latin, *resinosus* = resinous; the resinous nut)

(sect. **Anthoshorea**, white meranti)

Malay. For. Rec. 10 (1932) 234; Symington *op. cit.* (1943) 40; Ashton *op. cit.* (1968) 94, *op. cit.* (1982) 496; Anderson *op. cit.* (1980) 124; PROSEA *op. cit.* 412; Newman *et al. op. cit.* (1996) 201. **Type:** *Symington FMS 17512*, Peninsular Malaysia, Ulu Selangor, Serendah FR (holotype KEP).

Large emergent tree, to 50 m tall, to 1.3 m diameter; bole tall, cylindrical; crown hemispherical; buttresses small or tall, rather sharp. **Bark** dark grey, coarsely fissured and eventually chunkily flaky; inner bark pale and dark yellow laminated. *Young twig*, *inflorescence*, *leaf bud*, *parts of perianth exposed in bud*, *stipule outside*, *and petiole buff fugaceous puberulent*. **Twigs** terete, smooth, *c*. 2 mm diameter apically. Leaf buds ellipsoid, to 3 × 2 mm. **Stipules** elliptic, to 12 × 8 mm. **Leaves** *thinly coriaceous*, *undulate*, *drying tawny brown below*; *blade lanceolate to elliptic*, *base cuneate*, *apex with slender acumen to 1.2 cm long*; *midrib obscurely sunken above*, *slender but prominent below*; *lateral veins 10–13 pairs*, *slender but prominent below*, *not drying paler than blade*; *intercostal venation slender*, *hardly elevated below*, *scalariform*; *petiole 0.9–1.7 cm long*. **Inflorescences:** rachis terete, singly branched, to 8 cm long. **Flowers:** buds to 12 × 4 mm; corolla pale yellow; *stamens 15*, *connectival appendage c. 2½x as long as anther*, *glabrous*; *ovary ovoid*, *without stylopodium*, *glabrous*, *style c. 3x the length of ovary*, *trifid towards apex*. **Fruits:** pedicels to 4 mm long, to 3 mm diameter; *calyx lobes unequal*, *3 longer lobes to 9.5 × 2.5 cm*, *tapering to c. 7 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 7 × 0.6 cm*, *similar at base*. **Nuts** ovoid, to 1.5 × 1.5 cm, with to 6 mm long filiform style remnant, frequently resin-coated.

Vernacular name. Sarawak—*meranti belang* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and NW Borneo. In Sarawak recorded from Bau and Lundu districts (e.g., *S 397*, *S 9616* and *S 27005*).

Ecology. Rare, apparently confined to mixed dipterocarp forest, on yellow sandy soils over sandstone. Probably endangered.

104. **Shorea retusa** Meijer

(Latin, *retusus* = notched; the leaf apex)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

Act. Bot. Neerl. 12 (1963) 340; Meijer & Wood *op. cit.* 141; Burgess *op. cit.* 184; Ashton *op. cit.* (1968) 117, *op. cit.* (1982) 537; Anderson *op. cit.* (1980) 129; Newman *et al. op. cit.* (1996) 201. **Lectotype** (designated here)**:** *bb. 29715*, Borneo, C Kalimantan, Muara Tewe, Barito Ulu (hololectotype BO).

Canopy to low emergent tree, to 40 m tall, to 80 cm diameter; bole straight, cylindrical; crown becoming hemispherical, diffuse; buttresses low, rounded. **Bark** greyish brown, becoming shallowly but distinctly v-section fissured; inner bark yellowish brown; heartwood pale brown; dammar as pale cream-brown exudations. *Young parts greyish sericeous*, *glabrescent except on leaf bud*, *parts of calyx and petals exposed in bud*, *ovary*, *stylopodium*, *and stipule outside.* **Twigs** terete, much-branched, *c.* 1 mm diameter apically. Leaf buds ellipsoid, to 3 × 2 mm. **Stipules** elliptic, to 7 × 3 mm, caducous. **Leaves** *coriaceous*, *shiny*, *drying pale chocolate-brown*, *darker above*; *blade elliptic*, *3–9 × 1.5–5 cm*, *base cuneate*, *apex shallowly retuse*; *midrib obscurely sunken above*, *slender and raised but not prominent below*; *lateral veins 7–10 pairs*, *arched*, *ascending*, *very slender and hardly raised below*; *intercostal venation slender*, *scalariform*, *obscure below*; *petiole short*, *0.6–0.9 cm long.* **Inflorescences** terminal or axillary; rachis terete, to 10 cm long, branchlets bearing to 7 flowers; bracteoles elliptic, to 3 × 2 mm. **Flowers:** buds to 8 × 3 mm; corolla pale yellow; stamens 15, connectival appendage slender, equal or 2–4x the length of anther, becoming reflexed; ovary and stylopodium narrowly conical, crowned with a short glabrous style. **Fruit:** pedicels to 1 mm long; *calyx lobes unequal*, *3 longer lobes to 10 × 1.8 cm*, *tapering to c. 4 mm above the saccate base*, *2 shorter ones lorate-lobed*, *to 5.5 × 0.4 cm*, *similar at base*. **Nuts** ovoid, to 1.3 × 1.2 cm with 3 mm long style remnant.

Vernacular names. Sabah—*seraya daun tumpul* (preferred name). Sarawak—*meranti telur* (preferred name).

Distribution. Endemic in Borneo. Known in Sabah from Tawau district (e.g., *SAN 19569*, *SAN 21504* and *Villamal 87*) and in Sarawak from Bintulu, Kuching, Lundu, and Serian districts (e.g., *S 952*, *S 7579*, *S 10268*, *S 13373*, and *S 47099*). Also occurring in Kalimantan (e.g., *Ambriansyah & Arifin Berau 1067* and *bb. 29716*).

Ecology. Locally frequent in *kerangas* forest, mostly on shallow podsols over sandstone. Occurring in Bako NP; overall conservation status uncertain.

105. **Shorea revoluta** P.S.Ashton

(Latin *revolutus* = turned in; the leaf margin)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

Gard. Bull. Sing. 19 (1962) 304, *op. cit.* (1964) 215, *op. cit.* (1968) 117, *op. cit.* (1982) 543; Meijer & Wood *op. cit.* 142; Burgess *op. cit.* 184; Anderson *op. cit.* (1980) 129; Coode *et al.* (eds.) *op. cit.* 82; Newman *et al. op. cit.* (1996) 202. **Type:** *Smythies S 5914*, Borneo, Sarawak, Limbang district, Bt. Sagan (holotype K).

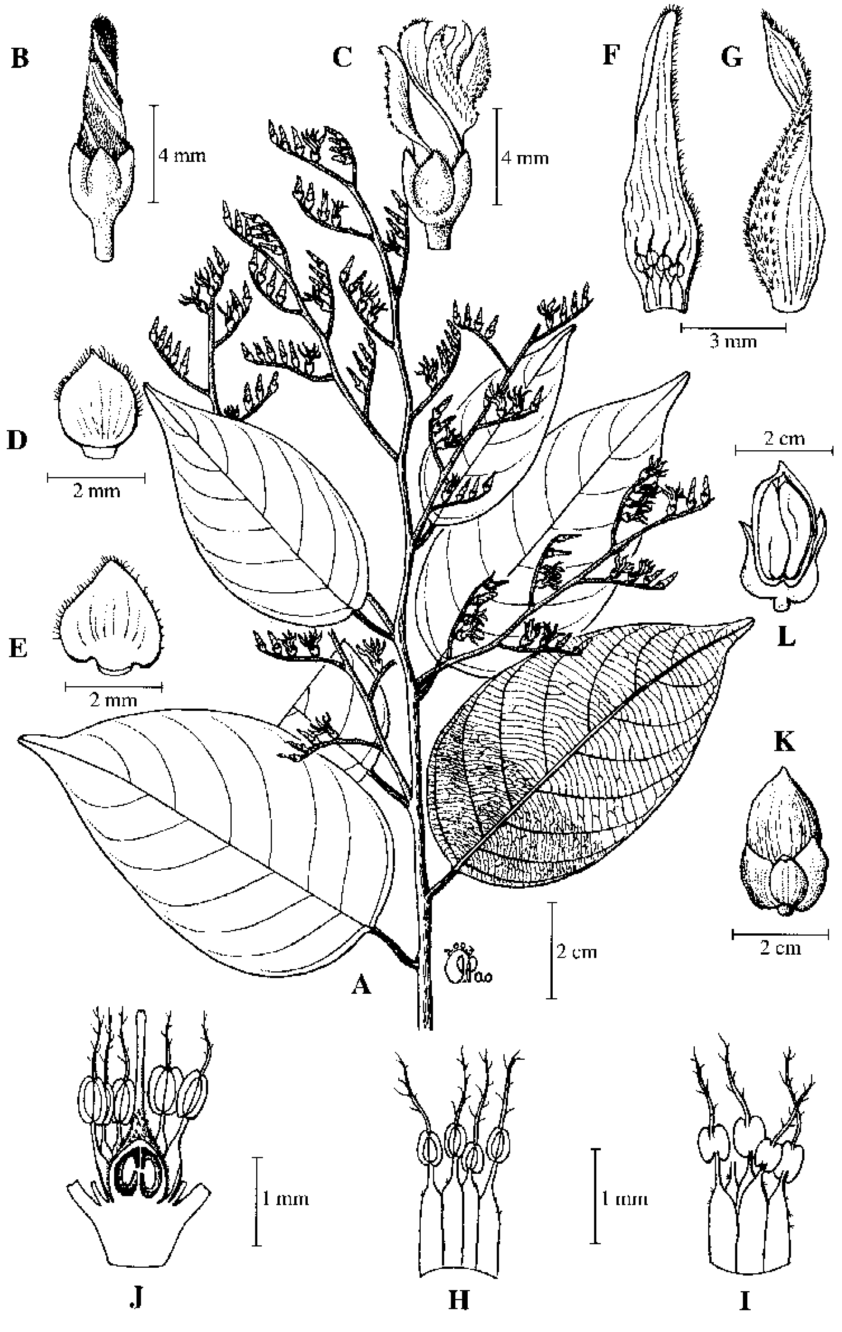

Fig. 28. *Shorea richetia.* A, flowering leafy twig; B, flower bud; C, opening flower; D, adaxial view of outer sepal; E, adaxial view of inner sepal; F, adaxial view of petal with stamens; G, abaxial view of petal; H, adaxial view of stamens; I, abaxial view of stamens; J, longitudinal section of open flower; K, fruit; L, longitudinal section of fruit. (A from *S 109*, B–J from *S 563*, K–L from *S 15254*.)

Low emergent tree, to 45 m tall, to 1 m diameter; bole cylindrical; crown hemispherical, diffuse; buttresses to 2 m tall, stout. **Bark** pale to dark chocolate-brown, frequently mottled with grey, prominently v-section fissured, the intervening ridges eventually crumbling in chunky flakes; dammar smears pale cream-yellow, common; inner bark and heartwood rust-red. *Twig*, *inflorescence*, *leaf bud*, *calyx and stipule outside*, *and petiole densely pale brown to fulvous scabrid-puberulent*; *veins below and midrib above sparsely so*; *parts of petal exposed in bud*, *nut and inside of stipules evenly pale buff puberulent*. **Twigs** at first slightly compressed and ribbed, *c*. 2–3 mm diameter apically. Leaf buds ovoid, compressed, subacute, 4–7 × 3–5 mm. **Stipules** elliptic to oblong, obtuse, to 15 × 7 mm, caducous. **Leaves** *coriaceous*, *drying warm tan-brown*; *blade ovate*, *10–15 × 5.5–10 cm*, *base obtuse to subcordate*, *margin prominently revolute*, *apex with slender acumen to 1.5 cm long*; *midrib more or less obscure and sunken above*, *prominent below*; *lateral veins 9–12 pairs*, *prominent below*, *arched*, *well-spaced*, *with glabrous axillary domatia*; *intercostal venation slender*, *scalariform*, *hardly elevated below*; *petiole 1.3–1.5 cm long*. **Inflorescences** terminal or axillary; rachis rigid, to 22 cm long. **Flowers:** *corolla dark red*; stamens 15, connectival appendage slender, as long as anther, becoming reflexed; ovary and stylopodium narrowly ovoid, style half their length, slender, glabrous. **Fruits:** pedicels to 1.5 mm long; *calyx lobes unequal*, *3 longer lobes to 7.5 × 1.3 cm*, *tapering to 3 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 3.5 × 0.2 cm*, *similar at base*. **Nuts** ovoid, to 1.5 × 0.8 cm, with *c*. 1.5 mm style remnant.

Vernacular names. Sabah—*seraya daun tajam* (preferred name). Sarawak—*meranti kerangas* (Malay).

Distribution. Endemic in Borneo. In Sabah known from Beaufort and Sipitang districts (e.g., *SAN 15135*, *SAN 55656*, *SAN 110013*, and *SAN 131905*) and in Sarawak from Lawas, Limbang and Marudi districts (e.g., *S 5618* and *S 11248*). Also occurring in Brunei (e.g., *BRUN 5646*, *S 5782* and *S 5814*).

Ecology. Locally frequent in *kerangas* forest, both on terraces and sandstone plateaux, at altitudes to 1200 m. Endangered by logging.

106. **Shorea richetia** Symington Fig. 28.

(after the former genus *Richetia*, now *Shorea* sect. *Richetioides*)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. S. S. 9 (1938) 330; Slooten *op. cit.* (1956) 335; Ashton *op. cit.* (1968) 89, *op. cit.* (1982) 474; Anderson *op. cit.* (1980) 123; Newman *et al. op. cit.* (1996) 203. **Type:** *Beccari PB 2888*, Borneo, Sarawak, Matang (holotype P; isotype L).

Main canopy tree, to 40 m tall, to 80 cm diameter; bole straight, cylindrical; crown dense, rather small, hemispherical; buttresses to 1 m tall, small, stout. **Bark** dull greyish brown, tardily cracking, then thinly oblong-flaking eventually leaving a scroll-marked new surface. *Twig apices*, *inflorescence*, *leaf buds*, *and stipules puberulent*; *ovary and nut buff pubescent*; *other parts glabrous*. **Twigs** terete, smooth, 1–2 mm diameter apically. Leaf buds ovoid, subacute, to 2 × 2 mm. **Stipules** lanceolate, to 5 × 2 mm. **Leaves** *thickly coriaceous*, *drying dark greyish green*; *blade broadly elliptic*, *5–11 × 3–6.5 cm*, *base broadly cuneate to occasionally subcordate*, *margin narrowly subrevolute*, *apex with broad*, *tapering acumen to 1 cm long*; *midrib evident*, *flat to shallowly furrowed above*, *prominent below*; *lateral* *veins 5–7 pairs*, *ascending*, *arched*, *prominent below*; *intercostal venation subscalariform*; *petiole stout*, *0.6–1 cm long*. **Inflorescences** terminal or axillary; rachis terete or compressed, glabrescent, lax, to 8 cm long, singly branched, branchlets bearing to 5 flowers; bracteoles deltoid, to 2 × 1 mm, fugaceous. **Flowers:** buds to 7 × 2 mm; petals lime-yellow; *stamens 16–17*, *connectival appendage at least 1½x the length of anther*; *ovary ovoid*, *without stylopodium*, *style 2–3x the length of ovary*, *columnar*, *tapering*, *pubescent in basal half*. **Fruits:** pedicels to 2 mm long, stout; *calyx lobes subequal*, *narrowly ovate*, *to 1.7 × 1 cm*, *acute*, *saccate*, *tuberculate*. **Nuts** obovoid, acute, to 2.5 × 1.5 cm.

Vernacular name. Sarawak—*lun melapi* (preferred name).

Distribution. Endemic in Borneo. In Sabah recorded from Tenom district (e.g., *SAN 64311*) and in Sarawak from Kuching and Lundu districts (e.g., *S 6404*, *S 15525*, *S 25451*, *S 32409*, and *S 32520*).

Ecology. Very local, in mixed dipterocarp forest on leached sandy clay soils, on low hills, at altitudes to 200 m. Recorded from Kubah NP; elsewhere endangered by land conversion.

107. **Shorea rotundifolia** P.S.Ashton Plate 4E.

(Latin, *rotundus* = round, *folius* = leaf; the distinctive leaf shape)

(sect. **Pachycarpae**, red meranti)

Gard. Bull. Sing. 22 (1967) 299, *op. cit.* (1968) 117, *op. cit.* (1982) 524; Anderson *op. cit.* (1980) 129; Newman *et al. op. cit.* (1996) 204. **Type:** *Smythies S 9470*, Borneo, Sarawak, Kapit district, Pelagus, Sg. Iran (holotype K; isotype KEP).

Low emergent tree, to 40 m tall, to 70 cm diameter; bole straight, cylindrical; buttresses to 80 cm tall and out, stout. **Bark** greyish brown and chocolate-mottled with a crimson ‘scrape’, smooth, hoop-marked, inner bark pinkish brown with pale patches; sapwood pink, relatively soft. *Young twig*, *petiole and stipule pruinose*; *petals shortly pubescent on parts exposed in bud*; *parts otherwise glabrous*. **Twigs** terete or slightly compressed at first, *c*. 3 × 2 mm apically; stipule scars amplexicaul, prominent. *Leaf buds lanceolate*, *compressed*, *large*, *to 20 × 8 mm*. **Stipules** *lanceolate-falcate*, *obtuse*, *to 60 × 20 mm*, *subpersistent*. **Leaves** *remaining distichous*, *coriaceous*, *shiny*, *drying dark purplish brown below*; *blade broadly ovate to orbicular*, *9–21 × 8–14 cm*, *base obtuse to cordate*, *apex cuspidate*, *acumen to 1 cm long*; *midrib evident above*, *flat*, *prominent below*; *lateral veins 9–11 pairs*, *arched*, *slender but prominent below*; *intercostal venation remotely scalariform*, *elevated below*; *petiole 3–4 cm long*, *somewhat geniculate*. **Inflorescences** terminal or axillary; rachis compressed, lax, to 15 cm long, regularly singly branched, branchlets bearing remote flowers; bracteoles elliptic-lanceolate, acute, to 10 × 6 mm. **Flowers:** buds to 10 × 4 mm; stamens 15, *connectival appendage c. 3x the length of anther*; ovary ovoid, glabrous, style and stylopodium spindle-shaped. **Fruits:** pedicels *c*. 6 mm long; *calyx lobes unequal*, *3 longer lobes spatulate*, *to 13 × 2.5 cm*, *tapering to c. 6 mm above the saccate base*, *2 shorter ones narrowly lanceolate*, *to 8 × 0.7 cm*, *similar at base*. **Nuts** ovoid, to 2.5 × 1.1 cm, with to 7 mm long style remnant.

Vernacular name. Sarawak—*langgai* (Iban).

Distribution. Endemic in Borneo. Confined to Bintulu and Kapit districts in C Sarawak (e.g., *S 22051* and *S 22053*).

Ecology. Local and rare, in scattered clumps on leached sandy clay soils along ridges, at altitudes to 400 m. Vulnerable.

Notes. It is possible that this entity may merely represent one or more varieties of *S. amplexicaulis*, with which it ofen grows. The small groups in which the species occur differ somewhat from one another, but their characters are internally constant. This extreme variation, unusual among dipterocarps, is nevertheless common among species in sect. *Pachycarpae* (see, for instance, under *S. macrophylla*, *S. pinanga* and *S. praestans*).

108. **Shorea rubella** P.S.Ashton

(Latin, *rubellus* = reddish; the drying leaf blade)

(sect. **Rubella**, red meranti)

Gard. Bull. Sing. 19 (1962) 307, *op. cit.* (1964) 216, *op. cit.* (1968) 118, *op. cit.* (1982) 500; Meijer & Wood *op. cit.* 143; Burgess *op. cit.* 184; Anderson *op. cit.* (1980) 129; Coode *et al.* (eds.) *op. cit.* 82; Newman *et al. op. cit.* (1996) 205. **Type:** *Ashton BRUN 3078*, Borneo, Brunei, Andulau FR (holotype K; isotypes KEP, L).

Medium-sized emergent tree, to 45 m tall, to 1.4 m diameter; bole tall, cylindrical; crown hemispherical, spreading, diffuse, becoming pale from below; buttresses to 2 m tall, stout, prominent. **Bark** pinkish brown, becoming coarsely deeply v-section fissured, eventually chunkily oblong-flaked; dammar smears rare, cream; inner bark rust-brown; heartwood pale pink. *Young parts evenly pale cream-buff puberulent*, *persistent only on inflorescence*; *leaf bud*, *parts of perianth exposed in bud*, *ovary*, *nut*, *and fruit calyx glabrescent.* **Twigs** 2–3 mm diameter apically, ridged and compressed on drying, becoming terete, stout; stipule scars *c.* 1.5 mm long, narrow, horizontal. Leaf buds narrowly ovoid to subfalcate, acute, 6–9 × 2–3 mm. **Stipules** hastate to falcate, acute, to 18 × 6 mm, caducous. **Leaves** *thickly coriaceous*, *sparsely cream lepidote below* (mature trees), *drying rich pinkish brown*; *blade broadly ovate but often somewhat irregularly shaped*, 9.5–14 × 6–8 cm, *base obtuse or broadly cuneate*, *margin sometimes subrevolute*, *apex with tapering acumen to 1 cm long*; *midrib evident*, *flat or shallowly furrowed above*, *prominent below*; *lateral veins 5–7 pairs*, *arched*, *well-spaced*, *prominent below*, *sometimes with minute pore-like axillary domatia*; *intercostal venation densely scalariform*, *slender*, *more or less obscure*; *petiole 2.3–3.5 cm long.* **Inflorescences** terminal or axillary; rachis ribbed on drying, to 15 cm long, branchlets lax, bearing to 5 flowers. **Flowers:** buds to 7 × 3 mm; petals pale pink, darker towards base; *stamens 15*, *subequal*, *filaments lorate*, *abruptly tapering below the large narrowly oblong equal anthers*, *connectival appendage short*, *tapering*, *becoming somewhat recurved*; *ovary small*, *ovoid*, *stylopodium indistinct*, *style filiform*, *c. 3x the length of ovary.* **Fruits:** *calyx lobes unequal*, *3 longer lobes to 8 × 1.5 cm*, *tapering to 5 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 5 × 0.6 cm*, *similar at base.* **Nuts** ovoid, to 1.8 × 1.2 cm, acute.

Vernacular name. Sarawak—*meranti laut putih* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Beaufort and Papar districts (e.g., *SAN 24812*, *SAN 24813* and *SAN A 1750*) and in Sarawak from Belaga, Bintulu, Kapit, Miri, and Tatau districts (e.g., *S 9474*, *S 15128* and *S 19577*). Also occurring in Brunei (e.g., *FMS 30574*, *FMS 35667*, *S 1925*, and *SAN 17564*).

Ecology. Locally frequent, on the deep yellow sandy soils of the subcoastal neogene sedimentary hills, the northernmost Rajang series, and the Arip rhyolite. Well represented in Lambir NP; elsewhere endangered.

109. **Shorea rubra** P.S.Ashton

(Latin, *ruber* = red; the leaf undersurface)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

Gard. Bull. Sing. 19 (1962) 309, *op. cit.* (1964) 217, *op. cit.* (1968) 118, *op. cit.* (1982) 545; Meijer & Wood *op. cit.* 144; Burgess *op. cit.* 166; Anderson *op. cit.* (1980) 129; Coode *et al.* (eds.) *op. cit.* 82; Newman *et al*. *op. cit.* (1996) 206. **Type:** *Smythies S 9475*, Borneo, Sarawak, Pelagus, Ulu Iran (holotype K; isotypes KEP, L, SAR).

Large emergent tree, to 50 m tall, to 1.3 m diameter; bole, tall, cylindrical; crown dense, cauliflower-shaped, brownish from below; buttresses to 2.5 m tall, stout. **Bark** dark chocolate to blackish, becoming deeply v-section fissured, eventually the ridges becoming chunkily flaky; dammar smears bright pale yellow; inner bark yellowish brown; heartwood deep purplish red. *Twig*, *inflorescence*, *bud*, *calyx outside*, *stipule*, *bracteole*, *petiole, midrib above*, *and leaf below densely persistently deep rufous brown scabrid puberulent*. **Twigs** terete, much-branched, to 1.5 mm diameter apically. Leaf buds compressed, ovoid, acute, 4–7 × 3–4.5 mm. **Stipules** hastate, to 16 × 5 mm. **Leaves** *thinly coriaceous*, *drying chocolate-brown overlain by deep rufous-brown tomentum*; *blade broadly ovate*, 8–13 × 4–7.5 cm, *base obtuse*, *margin narrowly revolute*, *apex with acumen to 1.3 cm long*; *midrib obscurely sunken above*, *slender but prominent below*; *lateral veins 11–13 pairs*, *prominent below*, *arched*; *intercostal venation densely scalariform*, *hardly elevated below*; *petiole 1–1.4 cm long*. **Inflorescences** terminal or axillary; rachis terete, rather rigid, to 14 cm long, branchlets compact, bearing to 5 flowers; bracteoles broadly ovate, subacute, to 4 × 3.5 mm. **Flowers:** buds to 7 × 4 mm; petals yellow; stamens 15, connectival appendage hardly reflexed; ovary and stylopodium ovoid-conical, with shorter glabrous style. **Fruits:** *calyx lobes unequal*, *3 longer lobes to 11 × 1.6 cm*, *tapering to 5 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 4.5 × 0.4 cm*, *otherwise similar*. **Nuts** broadly ovoid, to 1 × 0.9 cm, with *c*. 2 mm style remnant.

Vernacular names. Sabah—*seraya bingkai* (preferred name). Sarawak—*meranti merah kesumba* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Beaufort, Keningau, Kinabatangan, Ranau, Sandakan, Sipitang, and Tawau districts (e.g., *SAN 15193*, *SAN 22354*, *SAN 50702*, and *SAN 76795*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lawas, Limbang, Marudi, Miri, Sibu and Tatau districts (e.g., *S 3551*, *S 15875*, *S 22241*, *S 29499*, and *S 31723*). Also occurring in Brunei (e.g., *BRUN 784* and *FMS 48492*) and Kalimantan (e.g., *Jarvie et al. 5066*).

Ecology. Scattered in mixed dipterocarp forest, usually on well-drained leached sandy and clay soils, both on coastal hills, and on inland ridges, at altitudes to 800 m. Occurring in Lambir and Mulu NPs; elsewhere vulnerable.

110. **Shorea rugosa** F.Heim

(Latin, *rugosus* = wrinkled; the appearance imparted by the rough tomentum)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

Bull. Mens. Soc. Linn. Paris 2 (1891) 973; Merrill *op. cit.* (1921) 406; Symington *op. cit.* (1933) 132; Masamune *op. cit.* 496; Ashton *op. cit.* (1964) 218, *op. cit.* (1968) 118, *op. cit.* (1982) 540; Meijer & Wood *op. cit.* 144; Burgess *op. cit.* 154; Anderson *op. cit.* (1980) 129; PROSEA *op. cit.* 401; Coode *et al.* (eds.) *op. cit.* 82; Newman *et al. op. cit.* (1996) 207. **Type:** *Beccari PB 2638*, Borneo, Sarawak, Matang (holotype P).

Emergent tree, to 50 m tall, to 1.3 m diameter; bole cylindrical, straight; crown dense, cauliflower-shaped; buttresses to 2.5 cm tall, prominent, rather stout. **Bark** dark chocolate to blackish, in young trees mottled with fawn and ochre, becoming densely deeply v-section fissured, eventually powdery chunkily flaky; dammar bright yellow, in bole incrustations; inner bark yellowish brown; heartwood deep purplish red. *Young twig*, *inflorescence*, *leaf bud*, *flower calyx and stipule outside*, *petiole*, *and venation below densely purplish brown coarsely scabrid-tomentose*; *stipule inside*, *midrib above and blade below shortly evenly so*; *blade above and fruit calyx sparsely caducously so*; *parts of corolla exposed in bud*, *ovary*, *stylopodium*, *and nut evenly fulvous pubescent*. **Twigs** ribbed at first, becoming terete, to 2.5 mm diameter apically. Leaf buds ovoid, subacute, 4–6 × 3–5 mm. **Stipules** oblong-elliptic, subacute, to 14 × 5 mm. **Leaves** *thickly coriaceous*, *drying chocolate-brown scabrous below*; *blade oblong-ovate to oblong-obovate*, 9–17 × 4–9 cm, *base obtuse*, *margin more or less narrowly revolute*, *apex with broad acumen to 0.9 cm long*; *midrib obscurely sunken above*, *prominent below*; *lateral veins 14–19 pairs*, *prominent below*; *intercostal venation distantly scalariform*, *elevated below*; *petiole 1.3–2.3 cm long*, *stout.* **Inflorescences** terminal or axillary; rachis terete or slightly compressed, lax, to 12 cm long, branchlets bearing to 6 flowers; bracteoles elliptic, subacute, to 4 × 3 mm. **Flowers:** buds to 7 × 4 mm; petals yellow; stamens 15, connectival appendage short, reflexed; ovary and stylopodium conical, style short glabrous. **Fruits:** *calyx lobes unequal*, *3 longer lobes to 10.5 × 2.5 cm*, *tapering to 4–7 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 5 × 0.4 cm*, *similar at base*. **Nuts** ovoid, to 2.3 × 1.5 cm, acute.

Vernacular names. Sabah—*seraya buaya hantu* (preferred name). Sarawak—*meranti buaya hantu* (preferred name).

Distribution. Endemic in Borneo. Widespread but local in Sarawak and recorded from Belaga, Bintulu, Kapit, Kuching, Lundu, Miri, and Sibu districts (e.g., *S 7568*, *S 9466*, *S 15522*, *S 37854*, and *S 43398*). Reported from Sabah in Meijer and Wood (*op. cit.*) but collection now destroyed. Also occurring in Brunei (e.g., *BRUN 3036* and *S 2129*) and Kalimantan (e.g., *bb. 19974* and *bb. 29683*).

Ecology. Scattered, rarely common, in mixed dipterocarp forest on deep yellow sandy humic soils and grey leached sand in the ecotone to *kerangas*. Occurring in Bako, Lambir and Mulu NPs; endangered outside parks system.

111. **Shorea sagittata** P.S.Ashton Fig. 29.

(Latin, *sagittatus* = with two basal lobes pointing downwards; the fruit calyx lobes)

(sect. **Mutica**, subsect. **Auriculatae**, red meranti)

Gard. Bull. Sing. 22 (1967) 299, *op. cit.* (1968) 118, *op. cit.* (1982) 531; Anderson *op. cit.* (1980) 130; Newman *et al. op. cit.* (1996) 209. **Type:** *Sibat S 23616*, Borneo, Sarawak, Simunjan district, Balingian, Arip, Bt. Ijok (holotype K; isotype KEP).

Emergent tree, to 45 m tall, to 1.1 m diameter; bole straight, tall; crown evenly hemispherical, diffuse; buttresses to 3 m tall, stout, prominent. **Bark** pinkish brown and grey-mottled, becoming shallowly fissured, eventually chunkily oblong-flaky; inner bark pale yellow; heartwood reddish brown. *Leaf blade below cream-buff sericeous*; *corolla*, *ovary and nut puberulent*; *other exposed fleshy parts densely pinkish brown scabrid-puberulent*, *persistent except on fruit calyx.* **Twigs** ribbed, becoming terete, *c.* 2 mm diameter apically; stipule scars short, ascending. Leaf buds broadly ovoid, to 7 × 7 mm. **Stipules** ovate, subacute, to 10 × 8 mm, caducous. **Leaves** *thinly coriaceous*, *drying pale greyish brown*; *blade narrowly oblong to lanceolate*, *7–15 × 3–6 cm*; *midrib obscurely sunken above*, *prominent below*; *lateral veins 19–25 pairs*, *slender*, *dense*, *prominent below*; *intercostal venation densely scalariform*, *obscure*; *petiole 0.9–1.7 cm long.* **Inflorescences** terminal or axillary; rachis terete, to 7 cm long, branchlets short bearing to 3 flowers; bracteoles to 4 × 2 mm, narrow, acute. **Flowers:** buds to 6 × 3 mm; petals yellowish pink; stamens 15; ovary and stylopodium conical, style short, glabrous. **Fruits:** *calyx lobes unequal*, *3 longer lobes lorate-spatulate*, *to 12 × 2.5 cm*, *hardly tapering to the prominently sagittate-auriculate base with incrassate centre*, *2 shorter ones linear-lobed*, *to 2 × 0.3 cm*, *not auriculate*. **Nuts** ellipsoid, apiculate, to 1.5 × 0.8 cm, *glabrescent*.

Vernacular name. Sarawak—*meranti daun mata lembing* (preferred name).

Distribution. Endemic in Sarawak and known from Belaga, Bintulu, Kapit, Kuching, Mukah, Simunjan, and Tatau districts (e.g., *S 18316*, *S 23720*, *S 29166*, *S 53447*, and *S 60124*); not yet recorded from Sabah.

Ecology. Locally frequent, in mixed dipterocarp forest on moist leached clay hillsides, also floodplains, on sedimentaries and the Arip rhyolite. Endangered by land conversion.

112. **Shorea scaberrima** Burck Fig. 30.

(Latin, *scaberrimus* = very rough; the indumentum)

(sect. **Brachypterae**, red meranti)

Med. Lands Pl. Tuin 3 (1886) 22; Merrill *op. cit.* (1921) 406; Masamune *op. cit.* 497; Browne *op. cit.* 143; Ashton *op. cit.* (1964) 219, *op. cit.* (1968) 119, *op. cit.* (1982) 515; Meijer & Wood *op. cit.* 145; Burgess *op. cit.* 183; Anderson *op. cit.* (1980) 130; PROSEA *op. cit.* 402; Coode *et al.* (eds.) *op. cit.* 82; Newman *et al. op. cit.* (1996) 210. **Lectotype** (designated here)**:** *s.c. s.n.*, Cult. Hort. Bog. VIII D 54 (hololectotype BO).

Main canopy tree, to 40 m tall, to 1.1 m diameter; bole often misshapen; crown dense, rather irregular, more or less hemispherical; buttresses to 1.5 m tall, fairly stout. **Bark** at first remaining smooth, hoop-marked, dappled grey, ochre and fawn brown, becoming shallowly cracked and thinly patchily flaky; inner bark and heartwood coffee-coloured. *Young twigs*,

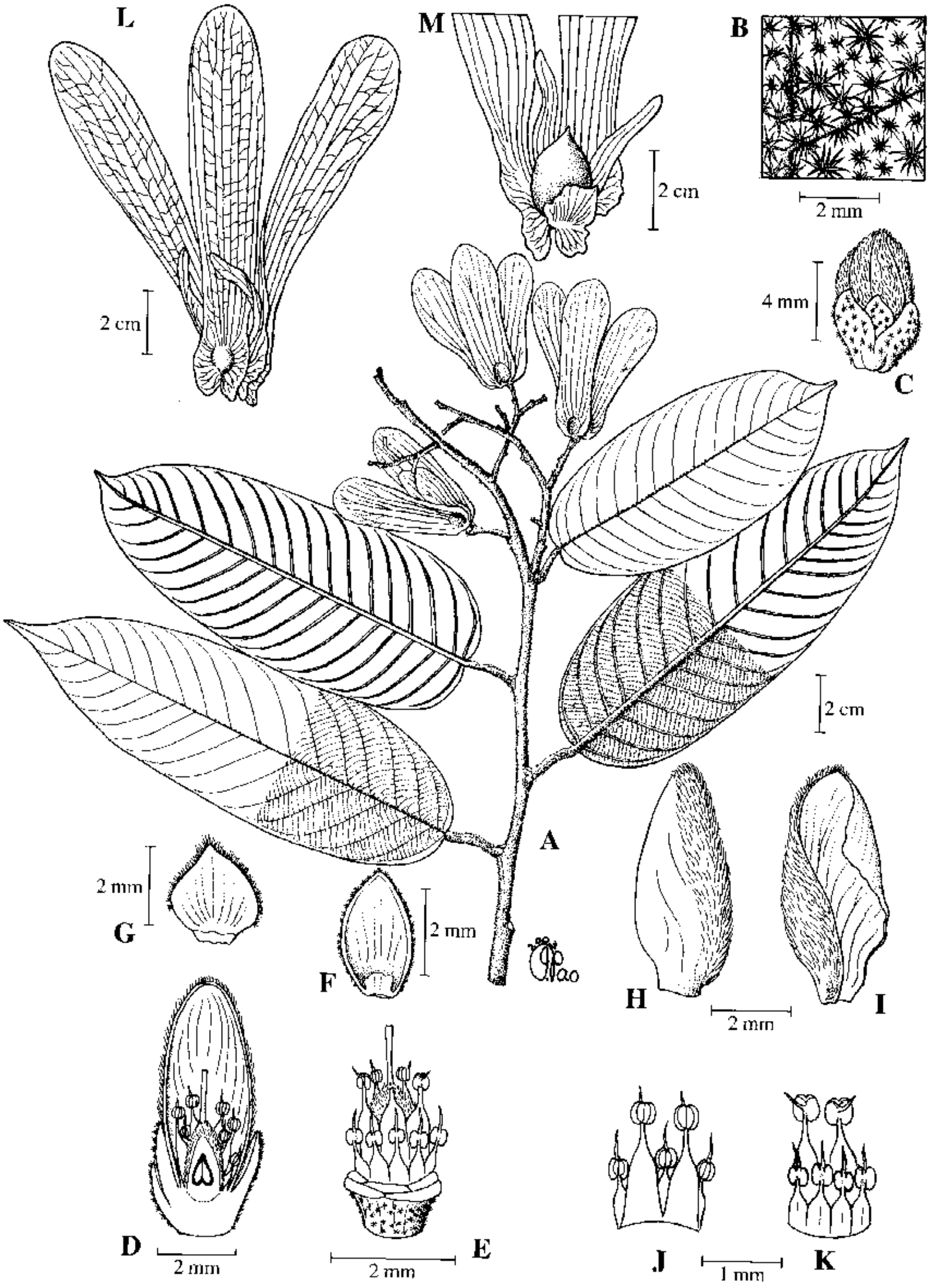

Fig. 29. *Shorea sagittata.* A, fruiting (young) leafy twig; B, detail of indumentum on lower leaf surface; C, flower bud; D, longitudinal section of flower bud; E, gynoecium and staments; F, adaxial view of outer sepal; G, adaxial view of inner sepal; H, abaxial view of petal; I, adaxial view of petal; J, adaxial view of stamens; K, abaxial view of stamens; L, fruit; M, fruit with the nut partially exposed. (A–B from *S 7609*, C–K from *S 29166*, L–M from *S 29652*.)

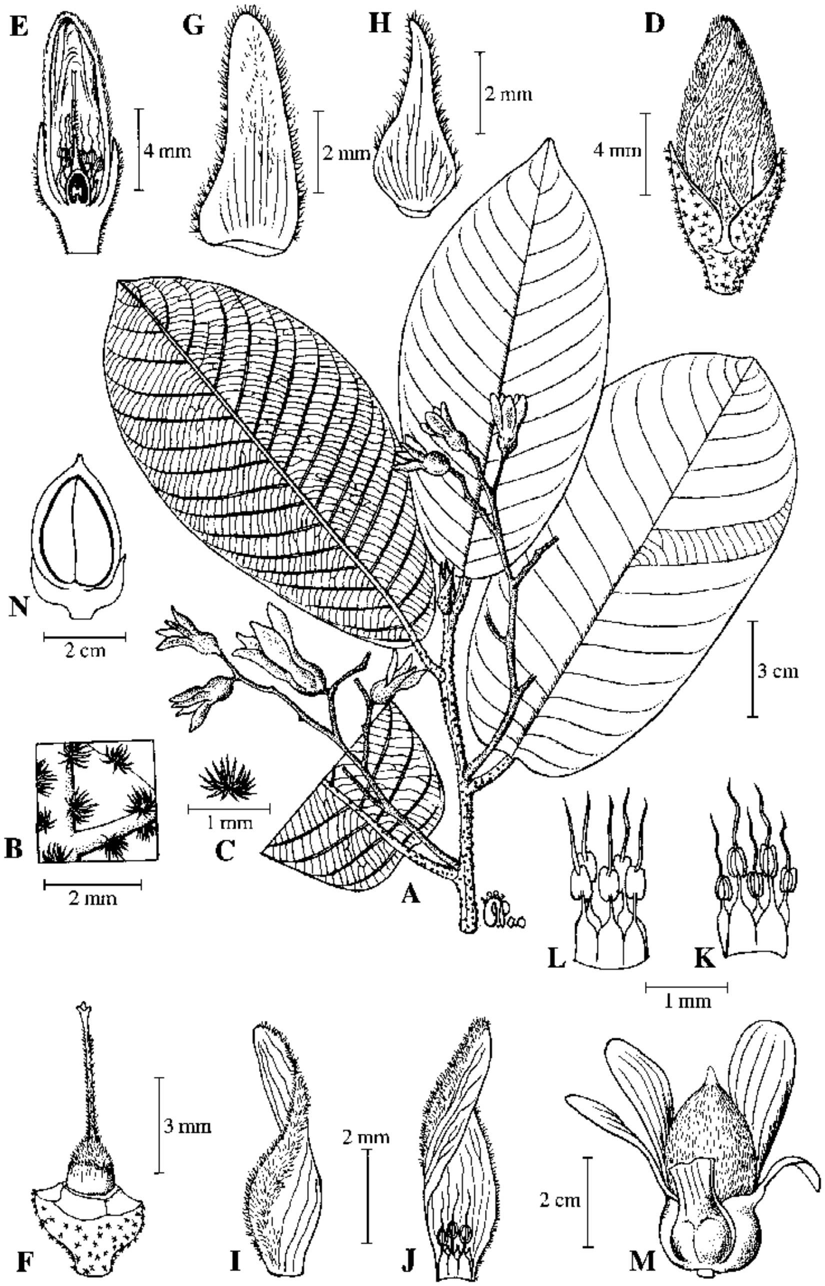

Fig. 30. *Shorea scaberrima.* A, fruiting (very young) leafy twig; B, detail of indumentum on lower leaf surface; C, side view of tufted hairs; D, flower bud; E, longitudinal section of flower bud; F, gynoecium; G, adaxial view of outer sepal; H, adaxial view of inner sepal; I, abaxial view of petal; J, adaxial view of petal; K, adaxial view of stamens; L, abaxial view of stamens; M, mature fruit with the nut partly exposed; N, longitudinal section of mature fruit. (A–B from *S 3285*, D–E from *S 2132*, F–N from *S 36915*.)

inflorescence, leaf bud, parts of calyx exposed in bud, stipule outside, petiole, leaf blade below, and midrib above more or less sparsely persistently golden brown scabrid-pubescent; parts of corolla exposed in bud, ovary, stylopodium, and nut evenly densely so; inside of stipule, bracteole and fruit calyx sparsely evenly so. **Twigs** ribbed at first, becoming terete, 2–3 mm diameter apically. Leaf buds broadly ovoid, subacute, slightly compressed, 4–6 × 4–5 mm. **Stipules** broadly hastate, to 18 × 8 mm, caducous. **Leaves** *thinly coriaceous to chartaceous, drying chocolate-brown below, purplish brown above; blade oblong-ovate to oblong-obovate, base obtuse, rarely subcordate, apex with tapering acumen to 0.8 cm long; midrib evident, flat to shallowly furrowed above, prominent below; lateral veins 14–17 pairs, slender but prominent below; intercostal venation scalariform, distinctly elevated below; petiole 1.8–2.5 cm long.* **Inflorescences** terminal or axillary; rachis ribbed to terete, to 8 cm long, singly branched, branchlets bearing to 3 secund flowers; bracteoles narrowly deltoid, to 4.5 × 3 mm. **Flowers:** buds to 8 × 5 mm; corolla pink; stamens 15, *connectival appendage at least 2x the length of anther; ovary ovoid, small, stylopodium and style at least 3x the length of ovary, stoutly filiform with glabrous apex.* **Fruits:** *calyx lobes unequal, 3 longer lobes nevertheless shorter than nut, to 4.5 × 1 cm, variable, tapering to c. 7 mm above the saccate base, 2 shorter ones linear-lobed, to 3 × 0.3 cm, similar at base.* **Nuts** *obovoid, to 5 × 2.5 cm, acute.*

Vernacular names. Sabah—*seraya mempelas* (preferred name). Sarawak—*meranti paya bersisik* (preferred name).

Distribution. Endemic in Borneo. Recorded in Sabah from Beaufort, Labuk Sugut, Papar, Penampang, Sipitang, and Tenom districts (e.g., *SAN 15062*, *SAN 16339*, *SAN 24276*, *SAN A 3016*, and *SAN A 3285*) and in Sarawak from Bau, Belaga, Bintulu, Kapit, Kuching, Lawas, Limbang, Lubok Antu, Lundu, Marudi, Miri, Mukah, Samarahan, and Tatau districts (e.g., *S 14974*, *S 15787*, *S 22218*, *S 25014*, and *S 47115*). Also occurring in Brunei (e.g., *BRUN 2001* and *KEP 80085*) and Kalimantan (e.g., *Suzuki K 9757* and *the type*).

Ecology. Locally common in mixed dipterocarp forest, on shallowly humic leached sandy clay, and well-drained skeletal clay soils; throughout the lowlands and along inland ridges, at altitude to 850 m. Common in Bako, Lambir and Mulu NPs; not vulnerable.

113. **Shorea scabrida** Symington

(Latin, *scabridus* = rough; the indumentum)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

Gard. Bull. S. S. 8 (1935) 287; Masamune *op. cit.* 497; Browne *op. cit.* 143; Anderson *op. cit.* (1963) 159, *op. cit.* (1980) 130; Ashton *op. cit.* (1964) 221, *op. cit.* (1968) 119, *op. cit.* (1982) 543; Meijer & Wood *op. cit.* 146; Burgess *op. cit.* 155, 183; PROSEA *op. cit.* 402; Coode *et al.* (eds.) *op. cit.* 82; Newman *et al. op. cit.* (1996) 211. **Type:** *Yusope S 171*, Borneo, Sarawak, Marudi district, Bt. Liman FR (holotype KEP).

Low emergent tree, to 45 m tall, to 1 m diameter; bole straight, cylindrical; crown becoming shallowly cauliflower-shaped, diffuse; buttresses to 1.5 m tall, stout. **Bark** at first mottled purplish brown and grey, becoming pink- to mauve-brown, widely v-section fissured; inner bark rich reddish brown with paler wedges; heartwood pinkish brown. *Young twig, inflorescence, leaf bud, midrib above, and blade and venation below persistently more or less sparsely tawny-brown scabrid-puberulent.* **Twigs** terete, much branched, *c.* 2 mm diameter apically; stipule scars short, horizontal. Leaf buds ovoid, obtuse, compressed, 2.5–5 × 1.5–3 mm. **Stipules** oblong, obtuse, to 6 × 3 mm, fugaceous. **Leaves** *coriaceous*, *drying orange-brown*; *blade obovate to elliptic*, *5–9 × 3–5 cm*, *base broadly cuneate*, *occasionally obtuse*, *apex retuse to shortly acuminate*; *midrib obscure and sunken above*, *prominent below*; *lateral veins 8–11 pairs*, *slender*, *raised but hardly prominent below*, *arched*, *occasionally with small pore-like domatia*; *intercostal venation slender*, *scalariform*, *barely elevated*; *petiole 0.9–1.1 cm long*. **Inflorescences** terminal or axillary; rachis terete or slightly compressed, to 8 cm long, branchlets short bearing to 7 flowers; bracteoles ovate, subacute, to 3.5 × 2.5 mm. **Flowers:** buds to 8 × 3.5 mm; petals cream, pink at base; stamens 15, connectival appendage slightly longer than anther, becoming reflexed; ovary and stylopodium narrowly conical, style almost as long as both, glabrous. **Fruits:** *calyx lobes unequal*, *3 longer lobes to 7 × 1.5 cm*, *tapering to c. 3 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 3 × 0.3 cm*, *similar at base*. **Nuts** ovoid, to 1 × 0.8 cm, shortly apiculate.

Vernacular names. Sabah—*seraya lop* (preferred name). Sarawak—*meranti lop* (preferred name).

Distribution. Sumatra and Borneo. In Sabah widespread, known from Beaufort, Labuk Sugut, Papar, and Sipitang districts (e.g., *SAN 15854*, *SAN 16681*, *SAN 24343*, *SAN 25431*, and *SAN 27969*) and in Sarawak from Belaga, Betong, Bintulu, Kapit, Kuching, Lundu, Marudi, Miri, Samarahan, Sibu, Simunjan, Sri Aman, and Tatau districts (e.g., *S 14997*, *S 15114*, *S 23367*, *S 32578*, and *S 41125*). Also occurring in Brunei (e.g., *BRUN 3015* and *BRUN 5542*) and Kalimantan (e.g., *bb. 6399* and *Jarvie & Ruskandi 5091*).

Ecology. Locally frequent, in the edge of mixed peat swamp forest, in *kerangas* forest on podsols, often in poor drainage, but also in mixed diptercarp forest on leached sandy and sandy clay soils, at altitudes to 1200 m. Occurring in Bako, Lambir, Mulu NPs; elsewhere vulnerable owing to land conversion.

Notes. A variable species. In dipterocarp forest the leaf is acuminate, the tomentum sparse, in *kerangas* and peat swamp forest the leaf is smaller, retuse, and the tomentum more dense; but there is much variation between the two.

114. **Shorea scrobiculata** Burck

(Latin, *scrobiculatus* = having the appearance of sawdust; the inflorescence indumentum)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

Med. Lands. Pl. Tuin 3 (1886) 223; Merrill *op. cit.* (1921) 406; Masamune *op. cit.* 497; Browne *op. cit.* 169; Ashton *op. cit.* (1963) 272, *op. cit.* (1964) 144, *op. cit.* (1968) 74, *op. cit.* (1982) 449; Anderson *op. cit.* (1980) 120; PROSEA *op. cit.* 432; Coode *et al.* (eds.) *op. cit.* 82; Newman *et al. op. cit.* (1998) 195. **Lectotype** (designated here)**:** *Beccari PB 2538*, Borneo, Sarawak, Matang (hololectotype K). **Synonyms:** *Shorea pierreana* F.Heim *op. cit.* (1892) 48; *S. meadiana* Symington *op. cit.* (1939) 366; *S. leptoderma* Meijer *op. cit.* 331 (Type: *Meijer SAN 21711*, Borneo, Sabah, Sepilok FR; holotype SAN; isotypes K, KEP, L, SAR), *syn. nov.*, Meijer & Wood *op. cit.* 180, Ashton *op. cit.* (1982) 450.

Main canopy or low emergent tree, to 40 m tall, tall 1.2 m diameter; bole straight, sometimes fluted; crown hemispherical, dense; buttresses to 0.7 m tall, thin, sometimes with flying buttresses. **Bark** dark yellowish to reddish brown, becoming cracked, oblong flaky, the flakes curling up from below, sometimes becoming shaggy. *Twig*, *inflorescence*, *leaf bud*, *parts of perianth exposed in bud*, *ovary*, *stylopodium*, *nut*, *bracteole*, *stipule*, *and petiole densely buff-puberulent*; *fruit calyx*, *midrib on both surfaces and veins below sparsely so.* **Twigs** terete, much-branched, slender, *c.* 1.5 mm diameter apically. Leaf buds ovoid, more or less compressed, 2–3 × 1–2 mm apically. **Stipules** hastate, *c.* 7 × 3 mm. **Leaves** *thinly coriaceous*, *drying yellowish brown below*, *mauve-grey above*; *blade narrowly ovate to oblong-lanceolate*, 5.5–11 × 2.5–4 cm, base broadly cuneate, apex with narrow acumen to 1 cm long; *midrib evident*, *elevated but somewhat furrowed above*, *slender but prominent with the veins below*; *lateral veins 10–12 pairs*, *ascending*, *dense*; *intercostal venation densely scalariform*, *hardly elevated*; *petiole c. 0.8 cm long.* **Inflorescences** terminal or axillary; rachis terete, slender, to 7 cm long, singly branched, branchlets bearing to 9 flowers; bracteoles elliptic, subacute, to 3 mm long, fugaceous. **Flowers:** buds to 6 × 2 mm; petals pink, cream at margin; *stamens 20–30*, *filament and anther glabrous*, *connectival appendage short*, *with 1*(*–2*) *apical bristle*(*s*); *ovary broadly ovoid*, *stylopodium narrowly cylindrical*, *shorter than ovary*, *style as long as stylopodium*, *tapering*, *columnar*, *glabrous.* **Fruits:** *calyx lobes unequal*, *3 longer lobes to 5 × 1.2 cm*, *tapering to 3 mm above the saccate base*, *2 shorter ones to 3.5 × 0.4 cm*, *otherwise similar*. **Nuts** ovoid, to 1 × 0.7 cm, with *c.* 1.7 mm style remnant.

Vernacular names. Sabah—*selangan batu kurap* (preferred name). Sarawak—*selangan batu zang* (preferred name).

Distribution. Peninsular Malaysia and Borneo. In Sabah recorded from Beaufort, Keningau, Kinabatangan, Lahad Datu, Ranau, Sandakan, and Tawau districts (e.g., *SAN 15012*, *SAN 21237*, *SAN 22848*, *SAN 76949*, and *SAN 126639*) and in Sarawak from Belaga, Bintulu, Kuching, Limbang, Lundu, and Miri districts (e.g., *S 9641*, *S 24694*, *S 32212*, *S 43462*, and *S 52753*). Also occurring in Brunei (e.g., *BRUN 740* and *SAN 17530*) and Kalimantan (e.g., *bb. 29700* and *Endert 2540*).

Ecology. In mixed dipterocarp forest on leached well-drained sandy and clay soils, on low hills and along shale ridges, at altitude to 700 m; locally frequent. Occurring in Bako, Kubah, Lambir and Mulu NPs; though its habitat is gradually reduced by land conversion, the species is not yet vulnerable.

115. **Shorea seminis** (de Vriese) Slooten Plate 4F.

(of Seminis, W Kalimantan)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

In Merrill, PEB (1929) 204, *op. cit.* (1941) 117; Keith *op. cit.* 44; Masamune *op. cit.* 497; Browne *op. cit.* 170; Ashton *op. cit.* (1963) 272, *op. cit.* (1964) 145, *op. cit.* (1968) 75, *op. cit.* (1982) 451; Meijer & Wood *op. cit.* 185; Burgess *op. cit.* 203, 211; Anderson *op. cit.* (1980) 120; PROSEA *op. cit.* 433; Kessler & Sidiyasa *op. cit.* 110; Coode *et al.* (eds.) *op. cit.* 83; Newman *et al. op. cit.* (1998) 196. **Basionym:** *Hopea seminis* de Vriese *op. cit.* 32. **Type:** *de Vriese s.n.*, Borneo, W Kalimantan, Sambas, Seminis (holotype L). **Synonyms:** *Hopea lanceolata* de Vriese *op. cit.* 32; *Shorea schefferiana* Hance *op. cit.* 303; *Isoptera borneensis* Scheff. *ex* Burck *op. cit.* (1886) 27; *S. borneensis* (Scheff. *ex* Burck) Pierre, For. Fl. Coch. 3 (1889) *t.* 234; *Ridleyinda borneensis* (Scheff. *ex* Burck) Kuntze *op. cit.* 65; *I. seminis* (Scheff. *ex* Burck) Burkill, Bull. Misc. Inform. Kew (1935) 317.

Large emergent tree, to 45 m tall, to 1.3 mm diameter, or more or less small leaning river bank tree; bole straight, cylindrical, or bowed; crown dense, oblong to hemispherical; buttresses to 2 m tall, thin. *Twig*, *inflorescence*, *leaf bud*, *parts of perianth exposed in bud*, *ovary*, *stylopodium*, *nut*, *stipule*, *bracteole*, *petiole*, *midrib on both surfaces*, *and veins below evenly more or less densely greyish brown puberulent*; *fruit calyx sparsely so.* **Twigs** at first ribbed, becoming terete, sparingly branched, slender, *c.* 1.5 mm diameter apically; stipule scars short, descending. Leaf buds ovoid to falcate, slightly compressed, 1.5–2.5 × 1–2 mm. **Stipules** oblong, to 7 × 3.5 mm. **Leaves** *thinly coriaceous*, *drying dull yellowish brown below with paler veins*, *mauve-grey above*; *blade oblong-ovate to lanceolate*, *9–18 × 2.5–8 cm*, *base obtuse or cuneate*, *apex with slender acumen 0.8–2 cm long*; *midrib evident*, *flat to shallowly furrowed above*, *slender but prominent below*; *lateral veins 9–15 pairs*, *ascending*, *slender but prominent below*; *intercostal venation densely scalariform*, *sinuate*, *more or less obscure*; *petiole 1–1.5 cm long.* **Inflorescences** terminal, axillary, or ramiflorous; rachis terete, to 10 cm long, singly branched, branchlets bearing to 5 flowers. **Flowers:** buds to 8 × 2 mm; petals cream, pink towards base; *stamens 30–40*, *filaments with a few long bristles*, *anthers glabrous*, *connectival appendage short*, *setose*; *ovary and stylopodium conical to hourglass-shaped*, *style short*, *glabrous.* **Fruits:** *calyx lobes subequal*, *incrassate*, *orbicular*, *rotate*, *to 2 × 1.8 cm* (usually smaller). **Nuts** *ovoid to globose*, *to 1 cm diameter*, *with to 2 mm long stout tapering style remnant.*

Vernacular names. Sabah—*selangan batu terendak* (preferred name). Sarawak—*engkabang terendak* (preferred name).

Distribution. Borneo and the Philippines. Known in Sabah from Kinabatangan, Kota Belud, Pensiangan, Sandakan, and Tawau districts (e.g., *SAN 16345*, *SAN 30438*, *SAN 36214*, *SAN 36652*, and *SAN 97082*) and in Sarawak from Bau, Belaga, Bintulu, Kapit, Kuching, Lawas, Limbang, Lundu, Marudi, Miri, Sibu, Sri Aman, and Tatau districts (e.g., *S 13781*, *S 20883*, *S 36684*, *S 43629*, and *S 68019*). Also occurring in Brunei (e.g., *BRUN 3359*, *Coode MC 6446* and *Forman 1166*) and Kalimantan (e.g., *Ambriansyah AA 2137*, *bb. 29271* and *Kostermans 12640*).

Ecology. Locally common, on clay and silt alluvium river banks along lowland rivers; occasionally at altitude to 300 m. Occurring in Mulu NP; elsewhere vulnerable owing to land conversion.

116. **Shorea slootenii** Wood *ex* P.S.Ashton

(D.F. van Slooten, 1891–1953, student of dipterocarps at Bogor, Indonesia)

(sect. **Mutica**, subsect. **Auriculatae**, red meranti)

Gard. Bull. Sing. 19 (1962) 312, *op. cit.* (1964) 222, *op. cit.* (1968) 119, *op. cit.* (1982) 529; Meijer & Wood *op. cit.* 147; Burgess *op. cit.* 184; Anderson *op. cit.* (1980) 130; Coode *et al.* (eds.) *op. cit.* 83; Newman *et al. op. cit.* (1996) 213. **Type:** *G.H.S. Wood SAN 15160*, Borneo, Sabah, Sipitang district, Mengalong FR (holotype K; isotypes KEP, L, SAN).

Low emergent or main canopy tree, to 40 m tall, to 1.6 m diameter; bole straight, cylindrical; crown hemispherical, *somewhat diffuse*, *the leaves hanging*; *buttresses to 1.5 m tall*, *stout.* **Bark** *becoming dark reddish brown*, *relatively deeply v-section fissured*; inner bark yellowish brown; heartwood orange-brown. *Twig*, *inflorescence*, *leaf bud*, *calyx and stipule outside*, *petiole*, *and leaf blade below densely persistently pale fulvous scabrid-*

tomentose, the hair tufts short, hard and knob-like; midrib above, inside of stipule, bracteole, parts of petal exposed in bud, ovary, stylopodium, and nut more or less densely shortly pubescent. **Twigs** compressed and ribbed at first, becoming terete but remaining verrucose, stout, to 5 × 3 mm apically; stipule scars long, cuneate, descending. *Leaf buds broadly ovate, 6–10 × 5–8 mm, obtuse, slightly compressed.* **Stipules** *oblong, to 25 × 8 mm, caducous.* **Leaves** *coriaceous, deeply concave and more or less corrugated between the veins, drying rust-brown below; blade oblong, 11–22 × 4–7 cm, base obtuse, apex with abrupt, tapering acumen to 1.5 cm long; midrib evident but deeply furrowed above, stoutly prominent below; lateral veins (25–)27–34 pairs, dense, shallowly furrowed above, prominent below, arched near the margin; intercostal venation scalariform, elevated below; petiole 1.7–2.3 cm long.* **Inflorescences** terminal or axillary; rachis stout, rigid, brittle, more or less compressed, to 18 cm long, branchlets short bearing to 4 flowers; bracteoles ovate to deltoid, obtuse, to 3 × 2 mm. **Flowers:** buds to 12 × 7 mm; petals pale yellow; stamens 15, *connectival appendage reflexed on 5 inner stamens only; ovary and stylopodium narrowly ovoid, style equal to ovary, broadly columnar, glabrous.* **Fruits:** calyx shiny; *calyx lobes unequal, 3 longer lobes oblong-lorate, to 17 × 1.8 cm, hardly tapering, the base forming a central incrassate disk bordered by to 4 mm wide lateral auricles, tapering abruptly at the pedicel, 2 shorter ones linear-lobed, to 5.5 × 0.7 cm, hardly auriculate at base.* **Nuts** ovoid, to 3.5 × 1.3 cm, with to 4 mm long slender tapering style remnant.

Vernacular names. Sabah—*seraya kepong kasar* (preferred name). Sarawak—*meranti kepong kasar* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Sipitang district (e.g., *SAN 15160*, *SAN 16922* and *SAN A 4570*) and in Sarawak from Bintulu, Kuching, Lawas, Lundu, and Miri districts (e.g., *S 1516*, *S 11053*, *S 15140*, *S 27119*, and *S 44067*). Also occurring in Brunei (e.g., *BRUN 3070*, *BRUN 3175*, *BRUN 3270*, *BRUN 5436*, and *FMS 35560*) and W and E Kalimantan (e.g., *bb. 7097* and *bb. 14509*).

Ecology. Locally frequent in mixed dipterocarp forest on leached thinly humic yellow sandy and sandy clay soils, on low hills at altitudes to 400 m; mostly in the neogeosyncline (with one record at Bt. Tanggi) in the central and northern part of its range. Occurring in Lambir NP; endangered outside parks system.

117. **Shorea smithiana** Symington Fig. 31, Plates 5A–B.

(J.S. Smith, State Forest Officer in Brunei, 1933–1936)

(sect. **Brachypterae**, red meranti)

Gard. Bull. S. S. 9 (1938) 345; Ashton *op. cit.* (1964) 223, *op. cit.* (1968) 119, *op. cit.* (1982) 503; Meijer & Wood *op. cit.* 148; Burgess *op. cit.* 155, 183; Anderson *op. cit.* (1980) 130; PROSEA *op. cit.* 403; Coode *et al.* (eds.) *op. cit.* 83; Newman *et al. op. cit.* (1996) 213. **Type:** *Smith FMS 30472*, Borneo, Brunei, Labi Hills (holotype KEP).

Large emergent tree, to 60 m tall, to 1.6 m diameter; bole tall, cylindrical; crown dense, large, hemispherical; buttresses to 2 m tall and wide, stout, notably straight-ridged. **Bark** dull greyish brown to greyish tawny, becoming v-section fissured and thinly oblong flaky; dammar in pale cream-yellow smears; inner bark dull pinkish brown; heartwood rich

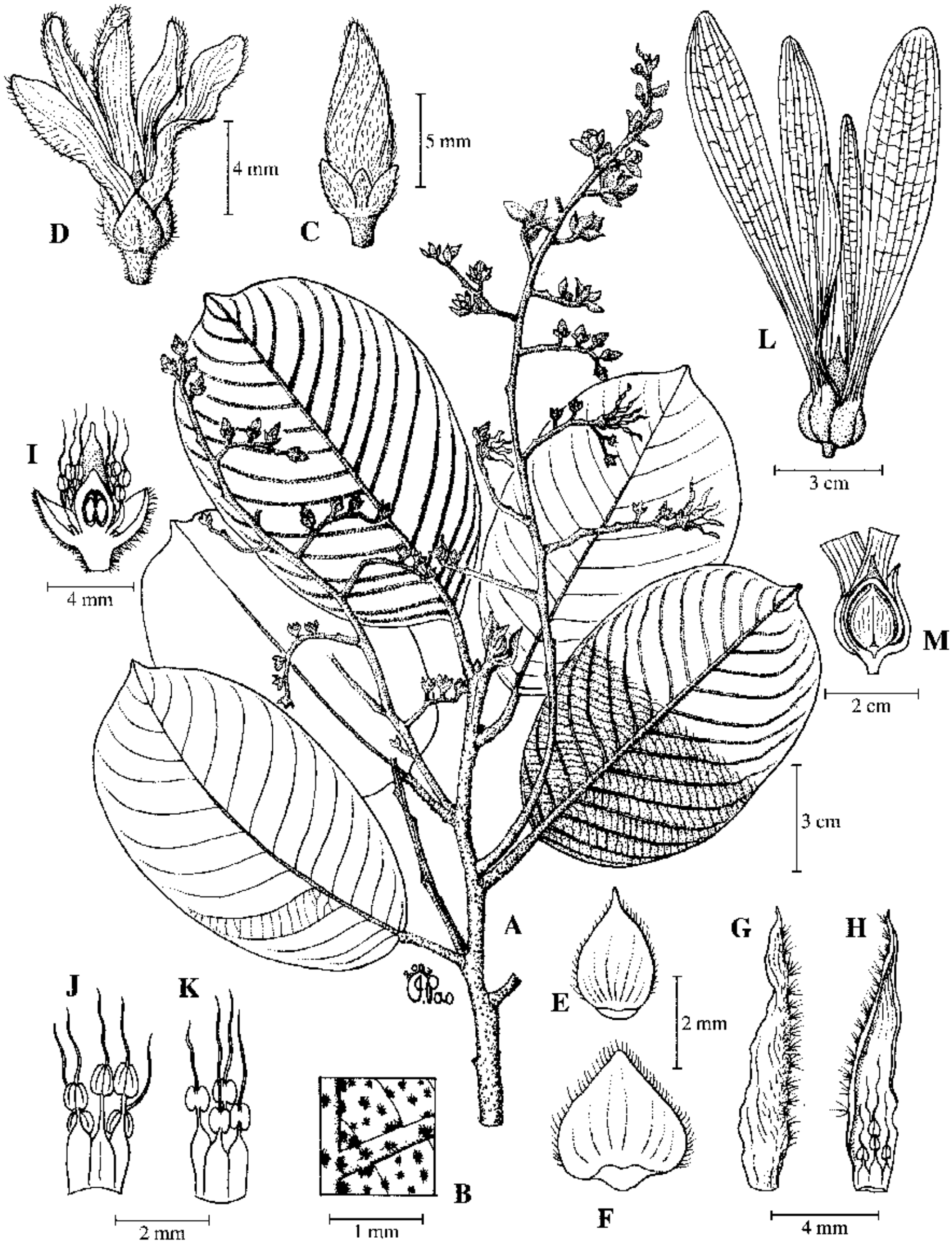

Fig. 31. *Shorea smithiana.* A, flowering leafy twig; B, detail of indumentum on lower leaf surface; C, flower bud; D, open flower; E, adaxial view of inner sepal; F, adaxial view of outer sepal; G abaxial view of petal; H, adaxial view of petal with stamens; I, longitudinal section of gynoecium with sepals and stamens; J, adaxial view of stamens; K, abaxial view of stamens; L, fruit; M, longitudinal section of fruit. (A–K from *S 46524*, L–M from *SAN 134957*.)

pinkish brown, relatively soft. *Young twig*, *inflorescence*, *parts of calyx exposed in bud*, *leaf bud*, *stipule outside*, *petiole*, *leaf below*, *and midrib above persistently greyish brown to rust scabrid-pubescent*; *stipule inside*, *bracteole*, *parts of corolla exposed in bud*, *ovary*, *stylopodium*, *and nut evenly pubescent*. **Twigs** ribbed, stout, 3–4 mm diameter apically; stipule scars to 2 mm long initially, broad, falcate. Leaf buds ovoid, 5–8 × 3–4.5 mm, slightly compressed. **Stipules** *broadly hastate*, *to 20 × 6 mm*, *caducous*. **Leaves** *thickly coriaceous*, *drying pinkish brown with greyish lepidote undersurface* (mature trees); *blade broadly obovate to oblong*, *sometimes ovate*, *12–20 × 6.5–11.5 cm*, *base obtuse to subcordate*, *apex with broad*, *tapering acumen to 1.5 cm long*; *midrib broad*, *more or less flat or shallowly furrowed above*, *prominent below*; *lateral veins 14–17 pairs*, *prominent below*, *spreading*, *arched*; *intercostal venation scalariform*, *sinuate*, *elevated below*; *petiole 2.2–2.8 cm long*. **Inflorescences** terminal or axillary; rachis terete, to 25 cm long, branchlets bearing to 7 secund flowers; bracteoles ovate, subacute, to 5 × 4 mm, caducous. **Flowers:** buds to 10 × 3 mm; petals pink; *stamens 22–26*, *connectival appendage at least 2x the length of anther*, *glabrous*; *ovary and stylopodium narrowly pyriform*, *style cylindrical*, *equal in length to both*, *glabrous*. **Fruits:** calyx glabrescent; *calyx lobes unequal*, *3 longer lobes to 20 × 2.8 cm*, *tapering to c. 1.3 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 13 × 0.9 cm*, *similar at base*. **Nuts** ovoid, to 2.7 × 1.8 cm, with to 3.5 mm tapering style remnant.

Vernacular names. Sabah—*seraya timbau* (preferred name). Sarawak—*meranti rambai* (preferred name).

Distribution. Endemic in Borneo. In Sabah widespread, known from Beaufort, Kinabatangan, Kudat, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Semporna, Sipitang, Tawau, and Tenom districts (e.g., *SAN 15168*, *SAN 15420*, *SAN 16427*, *SAN 19429*, *SAN 36587*, and *SAN 99912*) and in Sarawak from Belaga, Bintulu, Lawas, Limbang, Lundu, and Miri districts (e.g., *S 1833*, *S 24970*, *S 46531*, and *S 46763*). Also occurring in Brunei (e.g., *BRUN 5170* and *Niga NN 201*) and E and S Kalimantan (e.g., *Ambriansyah & Priyono AA 2192*, *bb. 22636*, *bb. 34403*, and *bb. 34463*).

Ecology. Locally common in mixed dipterocarp forest, on deep well-drained sandy clay soils, on hills at altitude to 400 m. Occurring in Lambir and Mulu NPs; Danum Valley Conservation Area and Sepilok FR; elsewhere vulnerable owing to land conversion.

118. **Shorea splendida** (de Vriese) P.S.Ashton

(Latin, *splendidus* = splendid)

(sect. **Pachycarpae**, red meranti)

Gard. Bull. Sing. 20 (1963) 279, *op. cit.* (1968) 119, *op. cit.* (1982) 522; Anderson *op. cit.* (1980) 130; PROSEA *op. cit.* 403; Newman *et al. op. cit.* (1996) 215. **Basionym:** *Hopea splendida* de Vriese *op. cit.* 28. **Lectotype** (designated here)**:** *de Vriese s.n.*, 'Borneo', Sambas (hololectotype L). **Synonym:** *Shorea martiniana* Scheff. *op. cit.* 408.

Main canopy tree, to 30 m tall, to 80 cm diameter; bole frequently misshapen; crown oblong to narrow hemispherical, with pendent branches and distichous hanging leaves; buttresses low, rounded. **Bark** smooth, hoop-marked, pale greyish brown; inner bark and heartwood pale pinkish brown. *Parts of corolla and nut densely cream pubescent*; *all parts otherwise glabrous*. **Twigs** *compressed*, *ribbed*, *c. 3 × 1 mm apically*; *stipule scars to 1 mm thick*, *prominent*, *amplexicaul. Leaf buds c. 8 × 6 mm*, *comprising loose aggregation of young leaves and stipules*. **Stipules** *ovate with cordate base*, *acute*, *subpersistent*, *prominent*, *to 25 × 15 mm*. **Leaves** *chartaceous*, *undulate*, *drying reddish brown*, *somewhat shiny*; *blade oblong*, *8.5–23 × 4.2–11 cm*, *base typically cordate*, *sometimes obtuse or cuneate*, *apex with slender and tapering acumen to 1 cm long*; *midrib very slender*, *evident but shallowly sunken above*, *prominent below*; *lateral veins 9–12 pairs*, *slender but prominent below*, *well-spaced*; *intercostal venation remotely scalariform*, *sinuate*, *elevated below*; *petiole 1.1–2.2 cm long*. **Inflorescences** terminal or axillary; rachis terete, to 20 cm long, singly branched, branchlets to 7 cm long, bearing to 10 flowers; bracts to 18 × 8 mm, caducous. **Flowers:** buds to 10 × 3 mm; petals pale pink; filaments connate along ¾ their length, connectival appendage 4–5x as long as anther; ovary ovoid, glabrous, style and stylopodium spindle-shaped. **Fruits:** pedicel to 7 mm long, to 4 mm diameter; *calyx lobes unequal but hardly longer than nut*, *3 longer lobes to 7.5 × 2.3 cm*, *tapering to c. 12 mm above the saccate base*, *2 shorter ones to 6.5 × 1.2 cm*, *otherwise similar*. **Nuts** *ovoid*, *to 5.5 × 3 cm*, *acute*.

Vernacular names. Sarawak—*engkabang bintang* (preferred name), *engkabang layar* (Iban).

Distribution. Endemic in Borneo. Known in Sarawak from Bau, Kuching, Lundu, Simunjan, and Sri Aman districts (e.g., *S 10307*, *S 22769*, *S 27347*, and *S 37048*). Also occurring in W Kalimantan (e.g., *bb. 29663*, *bb. 29717* and *bb. 31419*).

Ecology. Locally common, in dense clumps, on floodplains with sweet water. Occurring in Kubah NP; not vulnerable.

Uses. The secondmost important source of illipe nuts in NW Borneo, after *S. macrophylla*.

119. **Shorea stenoptera** Burck

(Greek, *steno-* = narrow, *pteron* = wing; the short narrow fruit calyx lobes)

(sect. **Pachycarpae**, red meranti)

Med. Lands Pl. Tuin 3 (1886) 11; Merrill *op. cit.* (1921) 407; Masamune *op. cit.* 497; Browne *op. cit.* 144; Ashton *op. cit.* (1968) 120, *op. cit.* (1982) 523; Anderson *op. cit.* (1980) 103; PROSEA *op. cit.* 403; Newman *et al*. *op. cit.* (1996) 216. **Lectotype** (designated here)**:** *de Vriese s.n.*, Borneo, W Kalimantan, Sintang (hololectotype L).

Main canopy tree, to 30 m tall, to 70 cm diameter; crown conical to narrowly hemispherical, dense, with somewhat pendulous branches; bole straight, tapering, often branching low; buttresses low, concave, relatively thin. **Bark** purplish brown and grey-mottled, smooth, hoop-marked; inner bark thin, yellowish brown; heartwood pinkish brown. *Twig apex*, *base of inflorescence*, *petiole and midrib above densely ochreous puberulent in young trees*, *becoming glabrous in mature trees*; *stipules occasionally sparsely sericeous*; *nut densely cream-brown puberulent*. **Twigs** somewhat compressed to terete, smooth, 3–4 mm diameter apically; *stipule scars pale*, *prominent*, *descending-amplexicaul.* Leaf buds ellipsoid, to 4 × 3 mm, usually obscured within stipules. **Stipules** *ovate-deltoid*, *obtuse*, *subauriculate at base*, *to 20 × 10 mm*, *subpersistent*. **Leaves** *thickly coriaceous*, *drying dark reddish-chocolate*; *blade oblong*, *18–40 × 8–22 cm*, *base broadly cuneate to cordate*, *apex with prominent*, *tapering acumen to 2 cm long*; *midrib evident*, *more or less flat above*, *stoutly* *prominent below as also the lateral veins*; *lateral veins 10–14 pairs*; *intercostal venation remotely scalariform*, *elevated below*; *petiole 2.3–4.5 cm long*, *stout.* **Inflorescences** terminal or axillary, *borne between leaf flushes at the axils of fugaceous rudimentary leaves along the twig*, *the twig there with short internodes* (visible when not reproducing); *bracteoles ovate*, *acute*, *to 6 × 4 mm*, *not at first caducous.* **Flowers:** buds to 7 × 3 mm; petals deep pink; stamens 15, filaments connate along ¾ of their length, connectival appendage 3–4x as long as anther; style and stylopodium spindle-shaped. **Fruits:** pedicel to 4 mm long and diameter; *calyx lobes unequal but hardly longer than nut*, *3 longer lobes to 7.5 × 2 cm*, *tapering to 10 mm above the saccate base*, *2 shorter ones to 5.5 × 0.8 cm*, *similar at base*. **Nuts** *ovoid*, *to 5 × 3 cm*, *apiculate*.

Vernacular name. Sarawak—*engkabang rusa* (Iban, preferred name).

Distribution. Endemic in Borneo. Recorded in Sarawak from Betong, Kuching, Lundu, Simunjan, and Sri Aman districts (e.g., *S 6506*, *S 10292*, *S 18010*, *S 27349*, and *S 34397*). Also occurring in W Kalimantan (e.g., the type and *bb. 29664*).

Ecology. Locally common, on humic soils on seldom flooded sandy alluvium, and in *kerangas* forest on more or less poorly drained podsols. Occurring in Bako and Kubah NPs; probably not vulnerable.

Use. An important source of illipe nuts.

120. **Shorea subcylindrica** Slooten

(Latin, *sub-* = more or less, *cylindricus* = cylindrical; the nut shape)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Reinwardtia 3 (1956) 331; Ashton *op. cit.* (1968) 90, *op. cit.* (1982) 476; Anderson *op. cit.* (1980) 123; Newman *et al. op. cit.* (1996) 217. **Type:** *Egon SA 615*, Borneo, Sarawak, Semengoh FR (holotype KEP).

Main canopy tree, to 30 m tall, to 50 cm diameter; bole straight, cylindrical; crown oblong, dense, irregular, small; buttresses low, rather thin. **Bark** chocolate-brown mottled with grey, hoop-marked. *Young twigs*, *leaf bud*, *inflorescence*, *parts of calyx exposed in bud*, *stipule and bracteole outside*, *and petiole sparsely caducous pale greyish brown puberulent*; *parts of corolla exposed in bud*, *ovary and nut densely persistently cream-brown sericeous to pubescent.* **Twigs** terete or somewhat compressed, rugulose, *c.* 2 mm diameter apically. Leaf buds ovoid, obtuse, *c.* 3 × 2 mm. **Stipules** lanceolate, to 10 × 2 mm, fugaceous. **Leaves** *coriaceous*, *somewhat shiny*, *drying tawny-brown below*, *greenish grey above*; *blade narrowly elliptic to lanceolate*, *9–24 × 4–12 cm*, *base cuneate*, *rarely obtuse*, *apex subcaudate*, *acumen to 1.5 cm long*; *midrib evident but shallowly furrowed above*, *stout and elevated but not prominent below*; *lateral veins 8–11 pairs*, *ascending*; *intercostal venation subreticulate*; *petiole 0.9–1.8 cm long.* **Inflorescences** terminal or axillary; rachis terete, lax, to 12 cm long, to trebly branched, branchlets bearing to 5 flowers; bracteoles deltoid, to 1 mm long, fugaceous. **Flowers:** buds to 3 × 1 mm; petals cream; connectival appendage somewhat longer than anther, glabrous; ovary ovoid, without stylopodium, style somewhat shorter than ovary, sericeous in the basal half. **Fruits:** pedicel *c.* 1 mm long; *calyx lobes subequal*, *ovate*, *acute*, *relatively thin*, *hardly saccate*, *to 1.2 × 0.9 cm*. **Nuts** ellipsoid, to 2.3 × 1.6 cm, acute.

Distribution. Endemic in Borneo. Known in Sabah from Beaufort district (e.g., *SAN 43270*) and in Sarawak from Kapit, Kuching and Lundu districts (e.g., *S 13708*, *S 29467*, *S 37781*, *S 44071*, and *S 68774*). Also occurring in W Kalimantan (e.g., *Suzuki 9669* and *Suzuki 9690*).

Ecology. Very local but common in mixed dipterocarp forest on leached sandy clay soils on low hills, at altitudes to 200 m. Critically endangered by forest conversion.

121. **Shorea superba** Symington

(Latin, *superbus* = magnificent; the stature and elegance of the tree)

(sect. **Shorea**, subsect. **Shorea**, *selangan batu*)

Gard. Bull. Sing. 17 (1960) 491; Ashton *op. cit.* (1964) 146, *op. cit.* (1968) 75, *op. cit.* (1982) 459; Meijer & Wood *op. cit.* 187; Burgess *op. cit.* 203, 211; Anderson *op. cit.* (1980) 121; PROSEA *op. cit.* 434; Coode *et al.* (eds.) *op. cit.* 83; Newman *et al. op. cit.* (1998) 197. **Type:** *Puasa FMS 38853*, Borneo, Sabah, Sandakan, Betotan (holotype KEP; isotypes L, SAN, SING).

Vast emergent tree, to 75 m tall, to 3.1 m diameter; bole tall, cylindrical; crown vast cauliflower-shaped, diffuse, pale from below; buttresses initially thin, extending to 4 m tall, concave, stout. **Bark** yellowish brown, becoming cracked and peeling with small oblong thin flakes, retaining an overall smooth appearance. *Twig*, *inflorescence*, *leaf bud*, *calyx outside*, *stipule*, *bracteole*, *petiole*, *veins and midrib on both surfaces more or less densely evenly pinkish brown puberulent*; *fruit calyx sparsely so*; *leaf blade below silvery lepidote.* **Twigs** compressed and ridged at first, becoming terete, much-branched, *c.* 2.5 × 1 mm apically; stipule scars pale, linear, horizontal. Leaf buds ovoid, to 4 × 3 mm, subacute, compressed. **Stipules** ovate-lanceolate, to 12 × 5 mm, fugaceous. **Leaves** *thinly coriaceous*, *conspicuously silvery lepidote below*; blade oblong, 7–12 × 4–7 cm, *base broadly cuneate*, *apex with broad*, *tapering acumen to 1 cm long*; *midrib and veins slender but evident*, *more or less narrowly furrowed above*, *slender but prominent below*; *lateral veins 16–24 pairs*, *dense*, *straight*, *appearing like a fish skeleton*; *intercostal venation densely scalariform*, *obscure*; *petiole 1–1.5 cm long.* **Inflorescences** terminal or axillary; rachis somewhat compressed and ribbed, to 8 cm long, branchlets bearing to 8 flowers; bracteoles lanceolate, to 5 mm long, caducous. **Flowers:** buds to 7 × 2 mm; corolla cream; *stamens c. 30*, *filaments and anthers glabrous*, *connectival appendage short*, *setose*; *ovary and stylopodium cylindrical to conical*, *style short*, *glabrous.* **Fruits:** *calyx lobes unequal*, *3 longer lobes to 6 × 1.2 cm*, *tapering to c. 8 mm at the saccate base*, *2 shorter ones linear-lobed*, *to 1.2 × 0.7 cm*, *similar at base.* **Nuts** ovoid, to 1.2 × 0.7 cm, apiculate.

Vernacular names. Sabah—*selangan batu daun halus* (preferred name). Sarawak—*selangan batu tulang ikan* (preferred name).

Distribution. Endemic in Borneo. In Sabah recorded from Beaufort, Kinabatangan, Labuk Sugut, Lahad Datu, Sandakan, Sipitang, and Tawau districts (e.g., *SAN 16910*, *SAN 19253*, *SAN 27146*, *SAN 33442*, and *SAN 61069*) and in Sarawak from Lawas, Limbang, Marudi, and Miri districts (e.g., *S 1538*, *S 1765*, *S 21411*, *S 24968*, and *S 26155*). Also occurring in Brunei (e.g., *KEP 80136*, *S 1660* and *S 1661*) and W and E Kalimantan.

Ecology. Scattered in mixed dipterocarp forest on well-structured clay soils in moist lower slope, low hill and floodplain sites. Occurring in Lambir and Mulu NPs, Danum Valley Conservation Area and Sepilok FR; elsewhere endangered owing to land conversion.

122. **Shorea symingtonii** Wood

(C.F. Symington, 1905–1943, master of the dipterocarps)

(sect. **Anthoshorea**, white meranti)

Gard. Bull. Sing. 17 (1960) 493; Meijer & Wood *op. cit.* 57; Burgess *op. cit.* 159; Ashton *op. cit.* (1982) 495; Newman *et al. op. cit.* (1996) 218. **Type:** *G.H.S. Wood & Charington FMS 35608* (= *SH 16522*), Borneo, Sabah, Sandakan district, Sepilok FR (holotype SAN; isotypes KEP, L).

Large emergent tree, to 50 m tall, to 1.5 m diameter; bole tall, cylindrical; crown hemispherical, somewhat irregular; buttresses large, stout. **Bark** greyish brown, cracked and crumbly flaky; inner bark cream and yellow laminated. *Twig apice*, *leaf bud*, *stipule*, *inflorescence*, *bracteole*, *flower calyx outside*, *and ovary sparsely caducously tawny puberulent*; *parts otherwise glabrous.* **Twigs** *compressed*, *stout*, *c. 4 × 2 mm apically.* Leaf buds ovoid-falcate, acute, *c.* 4 × 3 mm. **Stipules** lanceolate, to 12 × 5 mm, fugaceous. **Leaves** *coriaceous*, *corrugated between lateral veins*, *drying yellowish tawny*; *blade oblong to narrowly obovate* (*9–*)*10–18 ×* (*4–*)*5–8 cm*, *base obtuse to cordate*, *apex with tapering acumen to 1 cm long*; *midrib and lateral veins evident but furrowed above*, *slender but prominent below*; *lateral veins dense*, *18–22 pairs*; *intercostal venation densely scalariform*, *evident below*; *petiole stout*, *1–2 cm long.* **Inflorescences** terminal or axillary; rachis singly branched, lax, to 17 cm long, branchlets bearing to 5 flowers; bracteoles ovate-elliptic, acute, to 3 × 2 mm, fugaceous. **Flowers:** buds large, to 10 × 4 mm; *stamens 15*, *connectival appendage c. 2½x the length of anther*, *scarious towards apex*; *ovary ovoid*, *without stylopodium*, *style stoutly columnar*, *obscurely trifid apically.* **Fruits:** *pedicel c. 5 mm diameter*, *stout*, *expanding into the trumpet-shaped receptacle*; *calyx lobes unequal*, *3 longer lobes to 18 × 2.5 cm*, *tapering into the concave incrassate base*, *2 shorter lobes to 13 × 1.5 cm*, *narrower but otherwise similar.* **Nuts** *narrowly ellipsoid-ovoid*, *to 2.5 × 1 cm*, *glabrous*, *prominently apiculate*, *hidden within calyx lobe bases.*

Vernacular name. Sabah—*melapi kuning* (preferred name).

Distribution. Endemic in Borneo; confined to the eastern parts of Sabah, occurring in Kinabatangan, Lahad Datu, Sandakan, Semporna, and Tawau districts (e.g., *SAN 15539*, *SAN 16208*, *16348*, *SAN 23713*, and *SAN 39295*).

Ecology. Scattered in mixed dipterocarp forest on undulating land, on clay rich soils. Occurring in Sepilok FR; possibly endangered.

123. **Shorea tenuiramulosa** P.S.Ashton

(Latin, *tenuis* = slender, *ramulus* = small twig; the slender twig)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. Sing. 31 (1978) 42, *op. cit.* (1982) 478; Newman *et al. op. cit.* (1996) 219. **Type:** *Meijer SAN 39306*, Borneo, Sabah, Karamuak, Bt. Meliau (holotype K; isotypes KEP, SAN).

Small canopy tree, to 30 m tall, to 30 cm diameter. **Bark** greyish brown, smooth. *Inflorescence*, *stipule*, *bracteole*, *calyx outside*, *ovary*, *and nut greyish puberulent*; *caducous on twig*, *becoming sparse on fruit calyx lobes.* **Twigs** straight, sparsely branching, terete, rugulose, slender, pale, to 2 mm diameter apically. Leaf buds and stipule not seen. **Leaves** *thinly coriaceous*, *drying pale greyish brown*; *blade elliptic to lanceolate 9–24 × 4–11 cm*, *base broadly cuneate to obtuse*, *margin prominently undulate*, *apex shortly broadly acuminate*; *midrib prominent on both surfaces*; *lateral veins 8–9*(*–11*) *pairs*, *very slender but distinctly elevated below*, *slightly so above*, *arched*; *intercostal venation lax*, *reticulate*; *petiole 1.1–2 cm long*, *1.5 mm diameter*, *drying black but cream towards the end.* **Inflorescences** terminal, *or in axillary cluster of 3*, *or ramiflorous*; rachis slender, many-flowered; bracteoles elliptic, to 2 mm long, fugaceous. **Flowers:** buds to 5 × 2 mm; *stamens 15*, *anthers narrowly ellipsoid*, *connectival appendage c. 1½x the length of anther*; *ovary ovoid*, *without stylopodium*, *tapering into the somewhat shorter columnar glabrous style.* **Fruits:** subsessile; *calyx lobes subequal*, *oblong*, *obtuse*, *incrassate*, *saccate*, *patent*, *to 0.4 × 0.3 cm*. **Nuts** ellipsoid-cylindric, to 2.5 × 1.4 cm, apiculate.

Distribution. Endemic in Borneo. Known in Sabah from Lahad Datu, Sandakan and Tawau districts (e.g., *SAN 21621*, *SAN 21626*, *SAN 31475*, *SAN 36031*, and *SAN 54801*) and in Sarawak from Kapit and Lundu district (e.g., *S 29666* and *S 37815*).

Ecology. In mixed dipterocarp forest, on yellow sandy soil in Sarawak, and on shallow ultrabasic soil near the coast in Sabah. Rare and probably endangered.

124. **Shorea teysmanniana** Dyer *ex* Brandis

(J.E. Teijsmann, 1808–1882, Curator of Buitenzorg (now Bogor) Botanic Garden and the paramount collector of living plants in tropical Asia)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

J. Linn. Soc. Bot. 31 (1895) 100; Symington *op. cit.* (1933) 134, *op. cit.* (1943) 94; Masamune *op. cit.* 497; Browne *op. cit.* 144; Anderson *op. cit.* (1963) 159, *op. cit.* (1980) 130; Ashton *op. cit.* (1964) 225 *p.p.*, *op. cit.* (1968) 121, *op. cit.* (1982) 538; Meijer & Wood *op. cit.* 152; Burgess *op. cit.* 155, 183; PROSEA *op. cit.* 403; Coode *et al.* (eds.) *op. cit.* 83; Newman *et al. op. cit.* (1996) 220. **Type:** *Teijsmann s.n.*, Sumatra, Bangka (holotype K). **Synonyms:** *Shorea cochinchinensis* Pierre var. *oligoneura* Boerl., *op. cit.* 107; *S. balangeroides* Boerl., *op. cit.* 107; *S. paludosa* Foxw., *op. cit.* (1932) 277.

Emergent tree, to 45 m tall, to 1.3 m diameter; bole straight, cylindrical; crown cauliflower-shaped, diffuse; buttresses to 1.5 m tall, somewhat slender. **Bark** pinkish- to chocolate-brown, densely v-section fissured, hardly flaking; inner bark reddish brown; heartwood deep pinkish red. *Young twig*, *leaf bud*, *inflorescence*, *bracteole*, *and flower calyx outside persistently greyish brown puberulent*; *petiole caducously so*; *ovary*, *nut and parts of corolla exposed in bud densely buff-pubescent*. **Twigs** *compressed at first*, smooth, much-branched, *c.* 2 mm diameter apically; stipule scars pale, prominent, cuneate, 2 mm long. Leaf buds ovoid, subacute, depressed, 4–8 × 2–5 mm. **Stipules** ovate to oblong, subacute, to 14 × 5 mm, fugaceous. **Leaves** *coriaceous*, *glabrous*, *shiny above*, *drying rich reddish brown below*; *blade ovate*, *7.5–11 × 3.5–7 cm*, *base obtuse*, *apex with tapering acumen to 0.8 cm long*; *midrib and lateral veins obscurely sunken above*, *slender but prominent below*; *lateral veins 8–11 pairs*, *arched*, *with or without to 3 pairs of small axillary pore-like domatia*; *intercostal venation scalariform*, *hardly elevated*, *obscure*; *petiole 1.2–1.8 cm long*, *slender*. **Inflorescences** terminal or axillary; rachis terete, to 8 cm long, singly branched. **Flowers:** buds to 14 × 5 mm; stamens 15, connectival appendage short, becoming reflexed; ovary and stylopodium narrowly conical, style *c.* ½x the length of ovary and stylopodium, glabrous. **Fruits:** *calyx lobes unequal*, *3 longer lobes to 8 × 1 cm*, *tapering to c. 8 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 3 × 0.5 cm*, *similar at base*. **Nuts** ovoid, to 1.2 × 0.8 cm, with *c.* 2 mm slender style remnant.

Vernacular names. Sabah—*seraya bunga* (preferred name). Sarawak—*meranti lilin* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah rare and confined to Sipitang district (e.g., *SAN 19003* and *SAN 27969*) but in Sarawak widespread and known from Kuching, Lawas, Lundu, Marudi, Miri, Sarikei, Sibu, Simunjan, and Sri Aman districts (e.g., *S 3280*, *S 12419*, *S 14608*, and *S 77025*). Also occurring in Brunei (e.g., *BRUN 5834* and *FMS 35661*).

Ecology. Very local, but often frequent, in mixed peat swamp forest; rare in *alan* (*S. albida*) forest; once recorded at 900 m from the sandstone plateau on G. Bubong Rumah, Lawas, Sarawak. Recorded from Mulu NP; elsewhere endangered by deforestation.

125. **Shorea uliginosa** Foxw.

(Latin, *uliginosus* = growing in swamps; the habitat)

(sect. **Mutica**, subsect. **Mutica**, red meranti)

Malay. For. Rec. 10 (1932) 210; Ashton *op. cit.* (1967) 294, *op. cit.* (1968) 121, *op. cit.* (1982) 539; Anderson *op. cit.* (1980) 130; PROSEA *op. cit.* 404; Newman *et al. op. cit.* (1996) 221. **Type:** *Foxworthy CF 7938*, Peninsular Malaysia, Selangor, Bt. Ceraka FR (holotype KEP). **Synonym:** *Shorea rugosa* (*non* F.Heim) Symington var. *uliginosa* Symington *op. cit.* (1939) 372, *op. cit.* (1943) 91, Anderson *op. cit.* (1963) 159.

Large emergent tree, to 45 m tall, to 1.5 m diameter; bole tall, straight, cylindrical; crown irregularly hemispherical, dense, the twigs and leaves pendent; buttresses to 4 m tall, spreading, stout. **Bark** chocolate to purplish brown mottled with fawn and grey, deeply v-section fissured, the ridges eventually becoming powdery chunkily flaky; dammar incrustations pale yellow; inner bark rich reddish brown; heartwood purplish red. *Twig*, *leaf bud*, *stipule outside*, *inflorescence*, *calyx outside*, *bracteole outside*, *petiole*, *and blade below persistently pale chocolate-brown scabrid-pubescent*; *stipule within*, *midrib and veins above puberulent*. **Twigs** at first prominently ribbed below the petiole insertions, stout, 3–4 mm diameter apically; stipule scars short, pale, horizontal. Leaf buds ovoid, subacute, compressed, to 6 × 4 mm. **Stipules** elliptic, subacute, to 14 × 5 mm. **Leaves** *chartaceous*, *prominently concave*; *blade elliptic-oblong*, *12–22 × 6–12 cm*, *base broadly cuneate to subcordate*, *apex with acumen to 1 cm long*; *midrib barely evident*, *furrowed above*, *prominent below*; *lateral veins 16–21 pairs*, *slender but prominent below*, *arched near margins*, *dense*; *intercostal venation scalariform*, *elevated below*; *petiole 2.2–3.5 cm long.* **Inflorescences** terminal or axillary; rachis ribbed, to 16 cm long, doubly branched, branchlets bearing to 6 flowers; bracteole elliptic, subacute to 3 × 2 mm. **Flowers:** buds to 5 × 3 mm; petals pale yellow; stamens 15, connectival appendage about as long as anther, becoming reflexed; ovary and stylopodium conical, style the same length, columnar, glabrous. **Fruits:** *calyx lobes unequal*, *3 longer lobes to 6 × 1.2 cm*, *tapering to 4 mm at the* *saccate base*, *2 shorter ones linear-lobed*, *to 2 cm long*, *similar at base*. **Nuts** ovoid, to 0.8 × 0.6 cm, acute.

Vernacular name. Sarawak—*meranti buaya* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo known in Sarawak from Bintulu, Marudi, Miri, Sarikei, Sibu, and Sri Aman districts (e.g., *S 7908*, *S 14507*, *S 23287*, *S 27901*, and *S 32001*). Also occurring in W Kalimantan.

Ecology. Formerly locally abundant in the mixed peat swamp forests of the Lower Rajang, local and rare elsewhere; rare in *alan* (*S. albida*) forest. Endangered.

126. **Shorea venulosa** Wood *ex* Meijer

(Latin, *venulosus* = with tiny veins; the slender leaf venation)

(sect. **Brachypterae**, red meranti)

Act. Bot. Neerl. 12 (1963) 342; Wood & Meijer *op. cit.* 153; Burgess *op. cit.* 166; Ashton *op. cit.* (1964) 510, *op. cit.* (1968) 122, *op. cit.* (1982) 510; Anderson *op. cit.* (1980) 130; PROSEA *op. cit.* 404; Coode *et al*. (eds.) *op. cit.* 83; Newman *et al. op. cit.* (1996) 222. **Lectotype** (designated here)**:** *G.H.S. Wood SAN 15134*, Borneo, Sabah, Sipitang district, Menggalong FR (hololectotype K; isolectotypes KEP, SAN).

Large emergent tree, to 55 m tall, to 1.3 m diameter; bole straight, often somewhat tapering; crown cauliflower-shaped, diffuse; buttresses to 3 m tall, stout, prominent. **Bark** becoming dark chocolate-brown, deeply v-section fissured, the ridges becoming oblong flaky; dammar incrustations pale yellow; inner bark yellowish brown; heartwood dark brown. *Young parts at first grey sericeous*, *fugaceous except on leaf bud and stipule outside*; *inflorescence*, *parts of perianth exposed in bud*, *bracteole*, *ovary*, *and nut towards apex persistently cream puberulent*. **Twigs** terete, much-branched, slender, *c*. 1 mm diameter apically; *stipule scars pale*, *more or less horizontal*, *amplexicaul*. Leaf buds lanceolate-falcate, to 7 × 2 mm. **Stipules** hastate, to 20 × 3.5 mm, fugaceous. **Leaves** *coriaceous*, *drying chocolate-brown*, *often shiny above*; *blade ovate*, *6–10 × 3–5 cm* (*sometimes smaller on exposed peaks*, *larger on E Sabah ultrabasics*), *base obtuse*, *margin sometimes narrowly revolute*, *apex with slender acumen to 0.6 cm long*; *midrib obscure*, *sunken above*, *slender but prominent below*; *lateral veins 15–18 pairs*, *very slender*, *hardly elevated as also the scalariform intercostal venation, often with small glabrous pore-like, sometimes prominent and pustular, axillary domatia*; *petiole 1.7–3 cm long*, *slender*, *geniculate*. **Inflorescences** terminal or axillary; rachis terete, slender, lax, to 11 cm long, branchlets short, bearing to 10 flowers; bracteoles ovate, obtuse, to 3.5 × 2 mm. **Flowers:** buds to 5 × 2.5 mm; corolla pink; stamens 15, connectival appendage more than 2x the length of anther; ovary ovoid, without stylopodium, style somewhat shorter, filiform, puberulent at base. **Fruits:** *calyx lobes unequal*, *chartaceous*, *3 longer lobes to 6 × 1.3 cm*, *tapering to c. 3.5 mm above the saccate base*, *2 shorter lobes linear-lobed*, *to 3 × 0.3 cm*, *similar at base*. **Nuts** narrowly ovoid, to 2 × 0.8 cm, acute.

Vernacular names. Sabah—*seraya kerangas* (preferred name). Sarawak—*meranti tangkai panjang padi* (preferred name).

Distribution. Endemic in Borneo. In Sabah widespread and recorded from Keningau, Kinabatangan, Kota Marudu, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Sipitang, Tambunan, and Tawau districts (e.g., *SAN 15501*, *SAN 16359*, *SAN 26168*, *SAN 37855*, and *SAN 39323*) and in Sarawak from Bau, Kapit, Kuching, Lawas, Limbang, Lundu, Marudi, and Mukah districts (e.g., *S 10128*, *S 23287*, *S 26552*, *S 28977*, and *S 60087*).

Ecology. Locally common, on podsols in *kerangas* forest, and forest on ultrabasic rock throughout E Sabah; also common in lower montane *kerangas at* 1000–1600 m altitude, including on the Batu Tibang andesite. Occurring in Bako, Kinabalu and Mulu NPs; vulnerable elsewhere in the lowlands, less so on the mountains.

127. **Shorea virescens** Parijs

(Latin, *virescens* = becoming green; inference unclear)

(sect. **Anthoshorea**, white meranti)

In Fedde, Rep. 33 (1933) 244; Slooten *op. cit.* (1949) 240; Rojo, Kalikasan 5 (1976) 99; Ashton *op. cit.* (1978) 44, *op. cit.* (1982) 492; Anderson *op. cit.* (1980) 124; PROSEA *op. cit.* 413; Coode *et al.* (eds.) *op. cit.* 83; Newman *et al. op. cit.* (1996) 223. **Type:** *Frijd bb. 13898*, Borneo, W Kalimantan, Sanggau (holotype L; isotype BO).

Large emergent tree, to 50 m tall, to 1.6 m diameter; crown hemispherical, diffuse, large; bole tall, cylindrical; buttresses to 3 m tall, stout, prominent. **Bark** greyish tawny, becoming shaggily flaky, the flakes adhering and thick; dammar incrustations cream; inner bark cream and yellow laminated. *Twig*, *inflorescence*, *leaf bud*, *parts of perianth exposed in bud*, *bracteole*, *stipule*, *petiole*, *midrib on both surfaces*, *and venation below persistently densely greyish buff-pubescent*; *ovary minutely puberulent*; *nut glabrescent.* **Twigs** *compressed*, *stout*, *2.4–4 × 1.5–3 mm apically*; stipule scars to 2.5 mm long, horizontal. Leaf buds globose to stoutly ovoid, 2–3 × 4 mm. **Stipules** linear, acute, to 25 × 4 mm, caducous. **Leaves** *coriaceous*, *drying dull tawny-grey*; *blade obovate*, *8–15 × 4–8 cm*, *base obtuse to subcordate*, *apex with broad acumen to 7.5 mm long*; *midrib evident but deeply furrowed above*, *slender but prominent below as also the lateral veins*; *lateral veins 20–26 pairs*, *dense*, *ascending*; *intercostal venation very slender*, *scalariform*; *petiole 1.5–2 cm long.* **Inflorescences** terminal or axillary; rachis more or less compressed, to 10 cm long, singly branched; bracteoles narrowly lanceolate, to 8 mm long. **Flowers:** buds to 6 × 3 mm; *stamens 15*, *connectival appendage c. 2x the length of anther*; *ovary ovoid*, *without stylopodium*, *style filiform*, *equal to ovary.* **Fruits:** *calyx lobes unequal*, *3 longer lobes to 8 × 1.3 cm*, *tapering to 6 mm above the saccate base*, *2 shorter ones linear-lobed*, *to 5.5 × 0.5 cm*, *similar at base*. **Nuts** ovoid, to 2.2 × 1.2 cm, with *c.* 3 mm long tapering style remnant.

Vernacular name. Sarawak—*meranti sulang sulang* (preferred name).

Distribution. Borneo and the Philippines. In Sabah uncommon and known only from Lahad Datu, Sandakan and Tawau districts (e.g., *SAN 19573*, *SAN 34788* and *SAN 62950*) and in Sarawak recorded from Kapit, Lawas, Marudi, Miri, Serian, and Tatau districts (e.g., *S 29661* and *S 41149*). Also occurring in Brunei (e.g., *BRUN 323* and *SAN 17067*).

Ecology. Rare and scattered in mixed dipterocarp forest on clay soils, at altitude below 600 m, especially on low hills and slopes. Occurring in Lambir and Mulu NPs; highly vulnerable elsewhere owing to land conversion.

Note. The species was formerly confused with *S. confusa* and *S. lamellata* by me (Ashton *op. cit.* (1964) 164, 167, Meijer & Wood *op. cit.* 60, 66 and Burgess *op. cit.* 159).

128. **Shorea waltonii** Wood *ex* Meijer

(A.B. Walton, 1904–?, Conservator of Forest at Sandakan, 1952–1954)

(sect. **Brachypterae**, red meranti)

Act. Bot. Neerl. 12 (1963) 344; Wood & Meijer *op. cit.* 155; Burgess *op. cit.* 182; Ashton *op. cit.* (1982) 510; Newman *et al*. *op. cit.* (1996) 224. **Type:** *G.H.S. Wood SAN 16508*, Borneo, Sabah, Sandakan district, Sepilok FR (holotype K; isotypes A, KEP, SAN).

Large emergent tree; bole straight; crown spreading; buttresses large, stout. **Bark** deeply fissured and thinly oblong flaky; inner bark pale reddish brown; heartwood pink. *Twigs*, *leaf bud*, *stipule*, *petiole*, *venation below*, *and inflorescence more or less densely cream lepidote*; *flower calyx caducously so*; *ovary*, *nut*, *parts of petals exposed in bud*, *midrib*, *and sometimes veins above persistently cream-brown puberulent.* **Twigs** terete, smooth, stout, *c.* 3 mm diameter apically. Leaf buds small, conical. **Stipules** elliptic-lanceolate, acute, to 20 × 8 mm. **Leaves** *coriaceous*, *drying cream lepidote to mauve-brown below*; *blade oblong to ovate or obovate*, 10–25 × 5.5–12 cm, *base obtuse or shallowly cordate*, *apex abruptly acuminate*, *acumen to 1 cm long*; *midrib very slender but evident*, *deeply furrowed above*, *slender but prominent below as also the lateral veins*; *lateral veins 18–22 pairs*, *ascending except at base*; *intercostal venation remotely scalariform*, *hardly elevated below*; *petiole stout*, *2.5–4.5 cm long*. **Inflorescences** stout, terminal or axillary; rachis to 12 cm long, branchlets to 5 cm long; bracteoles to 10 cm long, amplexicaul. **Flowers:** buds to 8 × 3 mm; stamens 15, connectival appendage *c.* 2x the length of anther; ovary broadly ovoid, without stylopodium, style of equal length, puberulent in the basal half. **Fruits:** pedicel *c.* 3 mm long, stout; *calyx lobes unequal*, *3 major lobes to 14 × 2.3 cm*, *tapering to c. 11 mm wide above the saccate base*, *2 shorter ones lorate-lobed*, *to 10 × 0.8 cm*, *similar at base*. **Nuts** ovoid, to 2.5 × 1.8 cm, apiculate.

Vernacular name. Sabah—*seraya kelabu* (preferred name).

Distribution. Endemic in Borneo. In Sabah recorded from to Kinabatangan, Lahad Datu and Sandakan districts (e.g., *SAN 16903*, *SAN 17848*, *SAN 34486*, *SAN 36207*, and *SAN A 2985*). Also occurring in E Kalimantan (e.g., *Kostermans 13816*).

Ecology. Locally common in mixed dipterocarp forest on clay soils on low hills. Occurring in Sepilok FR; elsewhere endangered by forest clearance.

129. **Shorea woodii** P.S.Ashton

(G.H.S. Wood, forest botanist in Sabah 1953–1957 and a dipterocarp specialist)

(sect. **Pachycarpae**, red meranti)

TFSS 5 (2004) 480, *op. cit.* (1968) 122 ('63. *Shorea* sp.'). **Type:** *s.c. A 56/36*, Sarawak (holotype FHO).

Medium-sized tree, to 40 m tall, to 60 cm diameter; bole frequently branching low. **Bark** at first smooth, hoop-marked, eventually shallowly patchily fissured, with bright yellow dammar smears. *Young twig and petiole evenly densely golden brown caducous sericeous*; *parts otherwise glabrous*. **Twigs** 3–4 mm diameter apically, terete to somewhat compressed, becoming pale brown, smooth; internodes to 9 cm long; stipule scars amplexicaul, down-curved, prominent. Leaf buds ovoid, to 3 × 2 mm. **Stipules** lanceolate, acute, to 40 × 13 mm, rich crimson-red. **Leaves** rich crimson-red when young, coriaceous, drying greyish brown; *blade ovate-elliptic*, *20–37 × 11–20 cm*, *base to 1 cm peltate*, *apex tapering to 1.5 cm prominent slender acumen*; *midrib slightly raised above*, *prominently terete below*; *lateral veins 12–19 pairs*, *slender but prominent below*; *intercostal venation remotely scalariform*, *slender*; *petiole 3–7 cm long*, *terete*, *distally rugose*. **Inflorescences and flowers** unknown. **Fruits:** *3 longer calyx lobes narrowly spatulate*, *to 20 × 1.5 cm*, obtuse, tapering to *c.* 5 mm above the saccate base; 2 sorter ones unequal, to 17 × 0.8 cm, otherwise similar. **Nuts** ovoid, lustrons, to 3 × 2 cm, tapering to an apiculate style remnant.

Vernacular name. Sarawak—*engkabang lajan* (Iban).

Distribution. Endemic in Borneo; known only in Sarawak from Belaga and Kapit districts (e.g., *S 17801* and *S 22318*).

Ecology. Rare, as scattered individuals and small groups in mixed dipterocarp forest on damp sandy clay soils, on hillsides, at altitudes below 200 m. Critically endangered by land conversion.

Notes. Named after Geoffry Howarth Spencer Wood, who introduced me to the dipterocarps but whose inspiring stay with me in Brunei ended in tragedy.

130. **Shorea xanthophylla** Symington

(Greek, *xanthos* = yellow, *phullon* = leaf; the yellowish dry leaf)

(sect. **Richetioides**, subsect. **Richetioides**, yellow meranti)

Gard. Bull. S. S. 9 (1938) 342; Browne *op. cit.* 164; Slooten *op. cit.* (1956) 344; Ashton *op. cit.* (1964) 160, *op. cit.* (1968) 91, *op. cit.* (1982) 479; Meijer & Wood *op. cit.* (1964) 79; Burgess *op. cit.* 218; Anderson *op. cit.* (1980) 123; PROSEA *op. cit.* 420; Coode *et al.* (eds.) *op. cit.* 83; Newman *et al. op. cit.* (1996) 225. **Type:** *Puasa FMS 36776* (= *SH 3998*), Borneo, Sabah, Sandakan district, Betotan (holotype KEP).

Canopy tree, to 40 m tall, to 65 cm diameter; bole straight or often misshapen; crown dense, irregular, twigs somewhat pendent; buttress to 1 m tall, somewhat stout. **Bark** reddish fawn, smooth, hoop-marked, eventually vertically cracked and patchily thinly oblong-flaky; with small snail-like blackish dammar exudations. *Young twig and petiole buff caducous* *puberulent*; *inflorescence*, *stipule and bractole outside*, *leaf bud*, *parts of perianth exposed in bud*, *ovary*, *and nut persistently cream puberulent.* **Twigs** straight, terete, stout, drying black, 2–3 mm diameter apically. Leaf buds conical, to 3 × 1.5 mm. **Stipules** narrowly deltoid, concave, *c.* 8 × 3 mm. **Leaves** *bright crimson on opening*, *thinly coriaceous*, *often somewhat blistered between the veins*, *shiny*, *drying tawny brown*; *blade oblong-lanceolate*, *12–25 × 4–7 cm*, *base subcordate*, *obtuse or broadly cuneate*, *margin often narrowly subrevolute*, *apex with tapering acumen to 1 cm long*; *midrib broadly evident*, *more or less flat above*, *terete*, *prominent below*; *lateral veins 9–13 pairs*, *slender*, *raised below*, *arched and continuing within the margin*, *sometimes anastomosing to form a looped intramarginal vein*; *intercostal venation remotely subscalariform*; *petiole 0.8–1.5 cm long*, *drying black.* **Inflorescences** terminal, or in axillary cluster of 3, or ramiflorous; rachis angular, to 20 cm long, branchlets zigzag bearing to 9 flowers; bracteoles minute, fugaceous. **Flowers:** buds to 4.5 × 1.5 mm; petals cream-yellow; stamens 15, connectival appendage 1–2x the length of anther, ciliate distally; ovary ovoid-conical, tapering into stylopodium, style short, glabrous. **Fruits:** *calyx lobes subequal*, *broadly ovate*, *thickened*, *somewhat patent*, *saccate*, *c. 0.7 × 0.7 cm*. **Nuts** obovoid, *c.* 2 × 1.3 cm, subacute.

Vernacular names. Sabah—*seraya kuning barun* (preferred name). Sarawak—*lun barun* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Beaufort, Kinabatangan, Kota Merudu, Kudat, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Tawau, and Tenom districts (e.g., *SAN 16002*, *SAN 22510*, *SAN 37850*, *SAN 45118*, and *SAN 76775*) and in Sarawak from Belaga, Bintulu, Kapit, Miri, Sri Aman, and Tatau districts (e.g., *S 21858*, *S 27543*, *S 29099*, *S 43639*, and *S 46514*). Also occurring in Brunei (e.g., *BRUN 2605* and *BRUN 3126*).

Ecology. Locally common in mixed dipterocarp forest on clay soils over shale and basic volcanic rock at low altitude, rarely to 1000 m. Occurring in Lambir NP and Sepilok FR; vulnerable elsewhere owing to land conversion.

8. **UPUNA** Symington

(Iban name—*upun*)

Bull. Jard. Bot. Buitenz. 3, 17 (1941) 88; Meijer & Wood, Sabah For. Rec. 5 (1964) 327; Ashton, MDB (1964) 7, MDBS (1968) 3, FM 1, 9 (1982) 337; PROSEA 5, 1 (1993) 458.

Large main canopy trees with low stout buttresses in groups. **Bark** *dark brown*, *finely flaky*; *inner bark not laminated.* Young parts caducous, inflorescence persistently multicellular glandular tomentose and tufted tomentose. **Stipules** linear-tapering, *persistent and conceiling the small leaf buds*. **Inflorescences** *cymose.* **Flowers:** sepals imbricate but fused into a shallow cup at base free from ovary; *stamens 25–30*; filaments compressed, dilated at base and tapering to anthers; anthers oblong-ovoid, latrorse; *connectival appendage aristate*, *erect*, *many times the length of anther*; *ovary small*, *ovoid*, *without stylopodium*; *style filiform*, *about twice as long as ovary*, *trifid towards apex*; stigma minute. **Fruits:** *calyx with a distinct basal cup enclosing the base of but free from nut*; *lobes valvate*, *thinly chartaceous*, *2 much larger than the other 3.* **Nuts** ellipsoid, *triangular in cross-section*, *tapering at base*, *splitting loculicidally into 3 valves at germination*. **Seeds** *with arillode.* Germination epigeal; cotyledons subequal, cordate.

Distribution. A monotypic genus endemic in Borneo.

Uses. A heavy hardwood similar to *resak* but available in larger sizes. The timber is greasy and does not easily take glues.

Upuna borneensis Symington Fig. 32, Plates 5C–D.

(of Borneo)

Bull. Jard. Bot. Buitenz. 3, 17 (1941) 88; Browne, FTSB (1955) 171; Ashton *op. cit.* (1964) 7, *op. cit.* (1968) 3, *op. cit.* (1982) 339; Meijer & Wood *op. cit.* 327; Burgess, TBS (1966) 228; Anderson, CLTS (1980) 131; PROSEA *op. cit.* 458; Coode *et al.* (eds.), CLBD (1996) 84; Newman *et al.*, MDFB-MHHW (1998) 201. **Type:** *Flemmich FMS 48158*, Borneo, Brunei, Sg. Mau-Kargu headwaters (holotype KEP).

Large main canopy, occasionally low emergent tree, to 45 m tall, to 1.5 m diameter; crown dark, dense, hemispherical; *buttresses low and concave but stout and grouped around the base of the bole.* **Bark** *dark brown, densely cracked and flaking in narrow thin oblong pieces*; inner bark cream, homogeneous. **Sapwood** pale yellow, hard; heartwood coffee-brown; dammar exudations pale yellow, opaque. *Young parts caducous multicellular glandular tomentose*; *exposed living surfaces, leaf blade surfaces excepted, and ovary densely persistently pale chocolate-brown tomentose*; *blade undersurface white-tomentose, upper surface glabrescent.* **Twigs** to 3.5 mm diameter apically; stipule scars small. *Leaf buds ovoid-falcate, to 12 × 6 mm, subacute.* **Stipules** *linear, to 12 mm long.* **Leaves** *thinly coriaceous, frequently somewhat bullate*; *blade oblong to ovate, 9–17 × 4–9.5 cm, base cordate, margin revolute, apex with tapering acumen to 0.5 cm long*; *midrib prominent below, sunken above*; *lateral veins 16–20 pairs, well-spaced, arched towards margin, prominent below, frequently with short intermediates*; *intercostal venation scalariform, well-spaced, distinctly raised below*; *petiole 1–2.5 cm long, distinctly geniculate.* **Inflorescences** *to 3-axillary, to 15 cm long, much-branched*; *bracts lanceolate, to 10 × 3.5 mm, caducous.* **Flowers:** buds narrowly ovoid, to 5 × 2 mm; sepals subequal, imbricate, the 3 inner ones more attenuate, *united at the base forming a shallow cup free from the ovary*; *corolla deep purple with dark yellow margin, petals broadly ovate, subacute, becoming reflexed apically at anthesis*; *stamens 25–30, filaments broad at base, tapering abruptly and filiform at the subglobose anthers, connectival appendage c. 3x the length of anther, aristate*; *ovary ovoid, without stylopodium, style c. 3x as long as ovary, filiform, more or less trifurcate at apex.* **Fruits:** calyx remaining sparsely pubescent towards base; *lobes chartaceous, united into a c. 1 cm wide and deep conical basal cup tapering into a short pedicel, 2 outer lobes lanceolate, to 13 × 2.7 cm, tapering gradually to subacute apex, 3 inner ones to 7.5 × 1.7 cm, otherwise similar, subequal.* **Nuts** *narrowly ovoid, to 3.2 × 1.5 cm, triangular in cross-section, tapering to 5 mm slander style remnant.*

Vernacular names. Sabah and Sarawak—*upun* (preferred name). Sarawak—*penyau* (Iban), *upun batu* (Iban).

Distribution. Widespread in its chosen habitat, hence absent in most parts of Sabah and coastal E Kalimantan. In Sabah confined to SW parts and known from Sipitang district (e.g., *SAN 15184*) and in Sarawak widespread and recorded from Bintulu, Kuching, Lawas, Lundu, and Serian districts (e.g., *Hotta 15808*, *S 1522*, *S 6876*, and *S 10064*). Also occurring in Brunei (e.g., *BRUN 3091*, *FMS 37075* and *FMS 48457*) and W and SE Kalimantan (e.g., *bb. 29206* and *bb. 30145*).

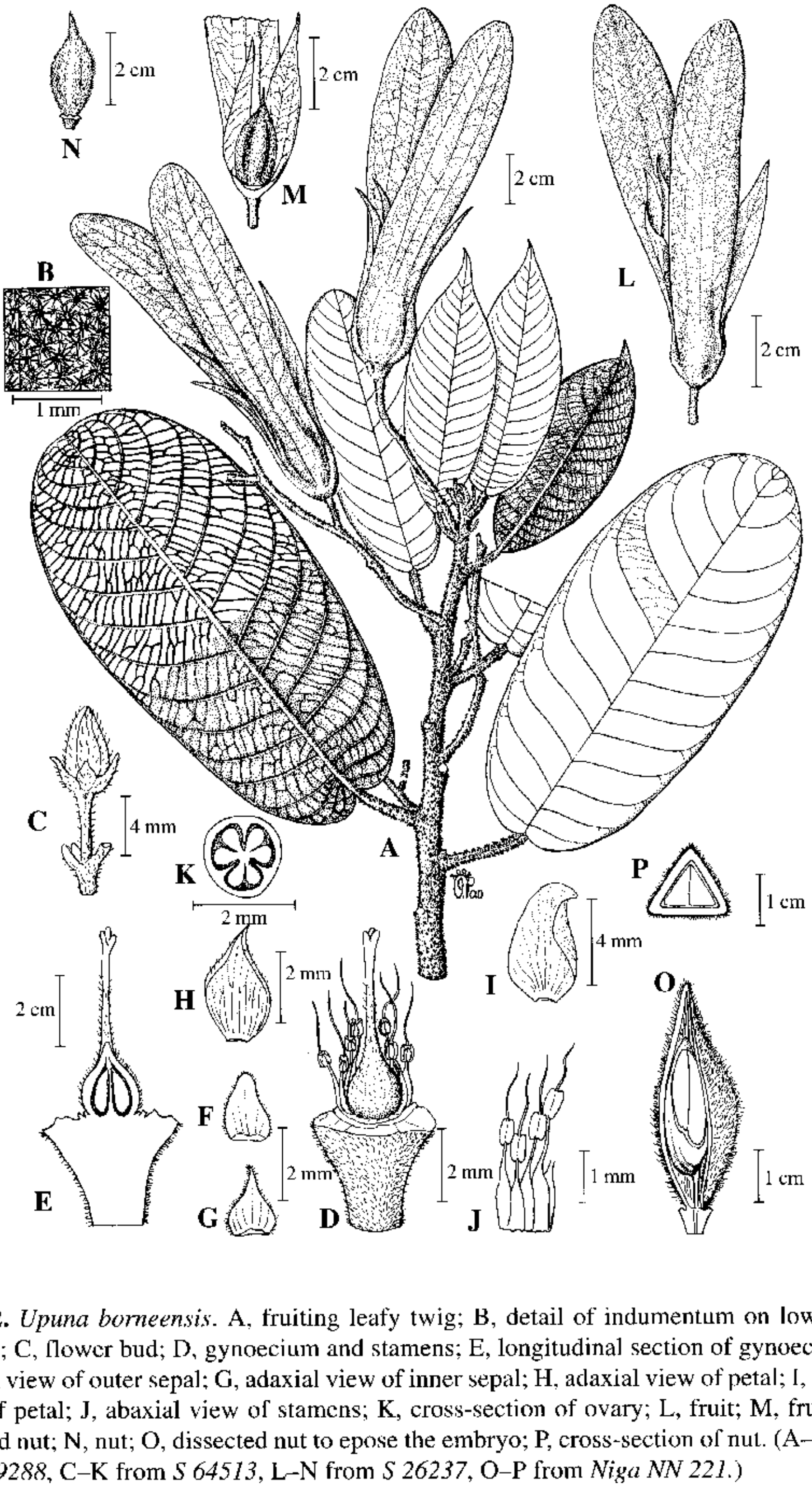

Fig. 32. *Upuna borneensis*. A, fruiting leafy twig; B, detail of indumentum on lower leaf surface; C, flower bud; D, gynoecium and stamens; E, longitudinal section of gynoecium; F, adaxial view of outer sepal; G, adaxial view of inner sepal; H, adaxial view of petal; I, abaxial view of petal; J, abaxial view of stamens; K, cross-section of ovary; L, fruit; M, fruit with exposed nut; N, nut; O, dissected nut to epose the embryo; P, cross-section of nut. (A–B from *KEP 19288*, C–K from *S 64513*, L–N from *S 26237*, O–P from *Niga NN 221*.)

Ecology. Scattered, locally frequent in mixed dipterocarp forest and the ecotone to *kerangas*, on deep yellow sandy soil on low hills, on sandstone and acid volcanics including the Arip rhyolite, at altitudes to 400 m. Occurring locally in Bako NP and recorded from Kubah NP; elsewhere vulnerable.

9. **VATICA** L.

(Latin, *vates* = prophet; alluding the use of dammar of one of the
Indian species in Hindu religions ceremony)

resak (preferred name)

Mant. 2 (1771)152; Brandis, J. Linn. Soc. Bot. 31 (1895) 128; Merrill, EB (1921) 408; Slooten, Bull. Jard. Bot. Buitenz. 3, 9 (1927) 67; Masamune, EPB (1942) 297; Browne, FTSB (1955) 96; Ashton, Gard. Bull. Sing. 20 (1963) 243; MDB (1964) 61, MDBS (1968) 25, FM 1, 9 (1982) 345; Meijer & Wood, Sabah For. Rec. 5 (1964) 301; Burgess, TBS (1966) 226; Anderson, CLTS (1980) 131; PROSEA 5, 1 (1993) 461; Coode *et al.* (eds.), CLBD (1996) 84. **Synonyms:** *Retinodendron* Korth., Kruidk. (1840) 55; *Isauxis* Reichb., Nom. (1841) 210; *Pteranthera* Blume, Mus. Bot. Lugd.-Bat. 2 (1852) 30; *Sunaptea* Griff., Notul. 4 (1854) 516; *Synaptea* Kurz, J. As. Soc. Beng. 39, 2 (1870) 65; *Pachynocarpus* Hook.*f.*, Trans. Linn. Soc. 23 (1860) 159; *Elaeogyne* Miq., Fl. Ned. Ind., Suppl. (1862) 460; *Retinodendropsis* F.Heim, C. R. Assoc. Fr. Pau 1892 (1893) 470; *Perissandra* Gagnep., Bull. Soc. Bot. Fr. 95 (1948) 27; *Brachypodandra* Gagnep. *op. cit.* 30.

Subcanopy to main canopy trees; bole frequently crooked; *buttresses stout*, *usually low*, concave; crown usually irregular, diffuse, juveniles irregularly branched. **Bark** usually greyish brown mottled, *smooth and hoop-marked*, in large trees becoming patchily flaked and occasionally scroll-marked, *with small lenticels hardly paler than bark surface*; *inner bark pale cream-brown*, fine-grained, homogeneous. **Sapwood** pale yellow, *dense*, *fine textured with ray ends not glistening on tangential surface*, hard or rarely soft; heartwood brown; dammar not generally present on bole, as whitish opaque smears if present. *Young parts usually more or less caducous powdery pubescent*. Leaf buds generally small, ovoid. **Twigs** usually pale greyish brown, smooth or rugose. Leaf buds generally small. **Stipules** variable. **Leaves** variable; *blade* more or less coriaceous, *flat or bullate*; midrib evident, usually more or less raised above though sometimes within a furrow (obscurely sunken in *V. rynchocarpa*); *lateral veins arched*, *distinctly raised but not usually prominent below*, *with short or no intermediate veins*, *not or obscurely joined into an intramarginal vein*; *intercostal venation usually reticulate but sometimes scalariform*, *more or less elevated on both surfaces*, *not drying darker than the leaf blade*; petioles variably but usually not geniculate. **Inflorescences** irregularly branched, racemose or partly cymose. **Flowers:** buds ovoid, spindle-shaped to lanceolate; *sepals more or less valvate*, subequal; petals narrowly oblong, usually cream often with a violet tinge, slightly contorted spreading at anthesis, not connate and falling separately; *stamens to 15 in 3 whorls*, filaments short, dilated at base, *anthers broadly oblong*, *glabrous*, *connectival appendage at most 1½x the length of anther*, stout, deltoid; *ovary ovoid-conical*, *superior or semi-inferior*, *pubescent*, *without stylopodium*, *style stoutly columnar*, *less than 2x the length of ovary*, *somewhat expanded apically with a conical 3-lobed stigma.* **Fruits:** calyx very variable; *lobes valvate and free to the base or united into a shallow cup enclosing less than 1/3 of the nut*, *if free 2 are longer than the other 3*, or all equal and revolute along the axis, or short, equal, reflexed to rotate, chartaceous to woody. **Nuts** variable, small or large, globose to ovoid with no persistent style remnant, *round in cross-section*, thin-walled or corky; *pericarp splitting loculicidally into 3 equal valves at germination.* **Germination** epigeal, or hypogeal and cryptocotylar;

cotyledons, if free, foliose, subequal, hardly photosynthetic, if remaining in the nut more or less fleshy, unequal.

Distribution. About 65 species, from South Asia and Indo-Burma to New Guinea. Thirty five species occur in Borneo, of which 23 are endemic and 33 occurring in Sabah and Sarawak.

Ecology. From brackish river banks to the lower edge of the upper montane forest, at altitudes to 1600 m; in all inland forest types except the *alan* peat swamps. Sometimes scattered, but usually quite common in the subcanopy, one or a small number of species common in any locality.

Uses. The larger hard-wooded species are used locally in construction. The seeds of the large fruited species were once used, though not apparently in Malaysia, for arresting the fermentation of rice and coconut wine.

Notes. *Vatica* species are the most difficult dipterocarps to recognise, and this explains why this common genus in our forests remains so poorly known. The smooth bark, absence of dammar smears, irregularly branched diffuse crown, and often nondescript leaves with reticulate intercostal venation can recall *Aporosa* or *Hydnocarpus*; but the scent of dammar is always descernable in freshly rubbed living tissue.

Key to *Vatica* species

(based on flowering and/or fruiting specimens)

1. Fruit calyx lobes equal or subequal, chartaceous or coriaceous, often becoming reflexed (sect. **Vatica**)……………………………………………………………………………2
   Fruit calyx lobes unequal, 2 longer than the other 3, chartaceous, not becoming reflexed (sect. **Sunaptea**)……………………………………………………………………15

2. Fruit calyx lobes thickened, corky, coalescing and adnate to nut forming a cup more or less enclosing it……………………………………………………………**31. V. umbonata**
   Fruit calyx lobes free……………………………………………………………………3

3. Fruit calyx lobes revolute but not reflexed, foliaceous and concealing the nut, subcordate……………………………………………………………………………………4
   Fruit calyx lobes more or less reflexed or spreading or rotate not concealing nut, not subcordate……………………………………………………………………………………6

4. Lateral veins at most 9 pairs, without distinct intermediates……………………………
   ……………………………………………………**32. V. venulosa** (subsp. **venulosa**)
   Lateral veins at least 10 pairs, with distinct intermediates…………………………….....5

5. Twig and inflorescence caducous buff-puberulent; petiole glabrous...….**6. V. chartacea**
   Twig, petiole and inflorescence persistently fulvous somewhat flocculent tomentose; petiole otherwise…………………………………………………………**15. V. havilandii**

6. Nut ovoid, verrucose, 2.5–4 cm diameter……………………7
Nut more or less globose, smooth, at most 2.2 cm diameter……………………9

7. Nut asymmetric; petiole at least 2 cm long……………………**27. V. rassak**
Nut symmetric; petiole at most 2 cm long……………………8

8. Leaf blade to 20 × 7 cm; lateral veins at most 14 pairs……………………**14. V. granulata**
Leaf blade at least 22 × 7 cm; lateral veins at least 15 pairs……**30. V. sarawakensis**

9. All parts glabrous……………………**1. V. albiramis**
Young parts and nut, at least, powdery tomentose to vinous-sericeous……………………10

10. Tomentum rufous; leaves drying greyish to pinkish brown……………………**13. V. globosa**
Tomentum vinous; leaves at first drying bluish greyish green or mauve-brown……11

11. Twigs compressed……………………**21. V. oblongifolia**
Twigs terete……………………12

12. Fruit calyx lobes chartaceous, hardly revolute……………………**10. V. dulitensis**
Fruit calyx lobes incrassate, becoming revolute……………………13

13. Nut to 2.2 cm diameter……………………**25. V. pedicellata**
Nut at most 1 cm diameter……………………14

14. Lateral veins 9–11 pairs……………………**28. V. rotata**
Lateral veins at least 12 pairs……………………**33. V. vinosa**

15. Fruit calyx lobes fused into a cup at base adnate to the nut……………………16
Fruit calyx lobes free……………………17

16. Lateral veins 7–10 pairs……………………**18. V. maritima**
Lateral veins 11–15 pairs……………………**22. V. odorata**

17. Twigs at first compressed……………………**7. V. compressa**
Twigs terete……………………18

18. Leaf blade obovate, thickly coriaceous, apex usually obtuse or retuse, margin revolute ……………………19
Leaf blade elliptic, lanceolate, oblanceolate, ovate or obovate, chartaceous, thinly coriaceous, or coriaceous, apex acuminate to subcaudate, margin not revolute………20

19. Inflorescence at most 3 cm long, fascicled and congested; petiole 1.2–2.5 cm long……
……………………**8. V. congesta**
Inflorescence to 20 cm long, lax; petiole 1–1.5 cm long……………………**9. V. coriacea**

20. Leaf undersurface persistently ochreous sericeous……………………**5. V. brunigii**
Leaf undersurface at most caducous pubescent……………………21

21. Lateral veins hardly or not more prominent below than above……………………22
Lateral veins distinctly more prominent below than above……………………26

22. Petiole at least 1 cm long……………………………………………………………23
    Petiole at most 1 cm long……………………………………………………………24

23. Petiole, twig and leaf bud at first cream-puberulent, glabrescent; leaf blade drying greyish green to honey-coloured, often shiny……………………………**12. V. glabrata**
    Petiole, twig and leaf bud more or less densely persistently pinkish brown pubescent; leaf blade drying dull rich pinkish brown………………………………**3. V. borneensis**

24. Ripe nut narrowly ovoid, tapering, acute, glabrous…………………**29. V. rynchocarpa**
    Ripe nut subglobose or broadly ovoid, obtuse or shortly mucronate, densely pubescent.. ……………………………………………………………………………………25

25. Midrib raised above; leaf base cuneate……………………………**17. V. mangachapoi**
    Midrib flat or slightly furrowed above; leaf base obtuse……………**23. V. parvifolia**

26. Inflorescence, petiole, lateral veins and midrib below persistently shortly pale brown scabrid-pubescent……………………………………………………………………27
    Inflorescence and sometimes petiole pink to rufous tomentose; lateral veins and midrib below caducously so, glabrescent……………………………………………………30

27. Inflorescence ramiflorous, fascicled…………………………………**24. V. patentinervia**
    Inflorescence axillary, not fascicled……………………………………………………28

28. Petiole to 2 cm long………………………………………………………**11. V. endertii**
    Petiole at most 1 cm long……………………………………………………………29

29. Leaf elliptic-obovate, base narrowly cuneate……………………………**4. V. brevipes**
    Leaf elliptic-oblong to lanceolate, base obtuse……………………**19. V. micrantha**

30. Leaf blade narrowly oblong-obovate, with many intermediate veins……...**20. V. nitens**
    Leaf blade elliptic, lanceolate, oblanceolate, broadly elliptic, or obovate, with a few or without intermediate veins……………………………………………………………31

31. Lateral veins prominently raised below; tomentum flocculent, long.......**16. V. maingayi**
    Lateral veins not prominent below; tomentum even, short…………………………32

32. Petiole at least 2 cm long; leaf blade drying rich pinkish brown, glistening; fruit calyx lobes to 8 × 2.5 cm……………………………………………………**2. V. badiifolia**
    Petiole at most 2 cm long; leaf blade drying dull greyish brown; fruit calyx lobes to 6 × 1.8 cm…………………………………………………………………**26. V. perakensis**

Key to *Vatica* species

(based on field characters)

1. Petiole glabrous or glabrescent, drying black………………………………………2
   Petiole cinereous or tomentose, not drying black……………………………………9

2. Lateral veins at most 6 pairs……………………………**1. V. albiramis**
Lateral veins at least 7 pairs……………………………3

3. Leaf blade oblong-obovate……………………………4
Leaf blade ovate, elliptic or lanceolate……………………………5

4. Leaf blade narrowly obovate, thickly coriaceous, concave, apex obtuse to retuse, margins revolute; petiole stout. In *kerangas* into the mixed dipterocarp forest ecotone……………………………**9. V. coriacea** (in part)
Leaf blade oblong-obovate, chartaceous, flat, apex prominently acuminate; petiole slender. In moist valleys and on river banks……………………………**6. V. chartacea**

5. Midrib sunken above……………………………**29. V. rynchocarpa** (in part)
Midrib flat or raised above……………………………6

6. Lateral veins raised on both surfaces. In upper dipterocarp forests at altitudes above 1000 m……………………………**12. V. glabrata**
Lateral veins unraised above. In lowland mixed dipterocarp forest……………………………7

7. Leaf blade drying rust-brown; lateral veins 9–11 pairs, sharply prominent below……………………………**16. V. maingayi** (in part)
Leaf blade drying pale greyish- or yellowish-brown; lateral veins 7–9 pairs, raised but not prominent below……………………………8

8. Leaf blade *c.* 12 × 5 cm; midrib drying hardly paler than petiole; intercostal venation subscalariform; wood soft. On river banks and in mixed dipterocarp forest……………………………**31. V. umbonata**
Leaf blade *c.* 9 × 4 cm, midrib drying paler than the dark petiole; intercostal venation reticulate; wood hard. In *kerangas* and mixed peat samp forest……………………………**17. V. mangachapoi** (in part)

9. Lateral veins hardly raised below, or no more than above……………………………10
Lateral veins distinctly raised below, more than above……………………………19

10. Twig at first compressed……………………………**7. V. compressa**
Twig terete……………………………11

11. Tomentum vinous-sericeous……………………………12
Tomentum greyish, yellowish, pink, rufous, or ochreous, not sericeous……………………………14

12. Leaf base cuneate……………………………**10. V. dulitensis** (in part)
Leaf base obtuse……………………………13

13. Leaf blade larger, 9–23 × 3.5–7.5 cm long, narrowly elliptic-lanceolate……………………………**25. V. pedicellata** (in part)
Leaf blade smaller, 5.5–10 × 3–5 cm long, broadly elliptic-ovate……………………………**28. V. rotata**

14. Leaf blade elliptic, coriaceous, drying dull, pale, pinkish brown; petiole at least 1.5 cm long, slender. In mixed dipterocarp forest on yellow sandy soils……………………………**3. V. borneensis**
Leaf blade drying dark-, tawny-, rufous-, yellowish- or greyish-brown; not coriaceous if elliptic; petiole at most 1 cm long. In river banks, peat swamp or *kerangas* forest……………………………15

15. Leaf blade narrowly obovate, apex obtuse to retuse, thickly coriaceous, concave, margin revolute; petiole stout; tomentum ochreous. In *kerangas* into the mixed dipterocarp forest ecotone…………………………………..…**9. V. coriacea** (in part)
Leaf blade ovate, elliptic or lanceolate, apex acute, acuminate to caudate, coriaceous to thinly coriaceous, flat, margin not revolute; or, if obovate, not coriaceous and with slender petiole; tomentum otherwise. In different forest habitats……………….…16

16. Tomentum pale pinkish- to rufous-brown…………………………………………....17
Tomentum greyish brown or cream-yellow…………………………………..…18

17. Lateral veins *c.* 8 pairs; midrib flat above; leaf blade narrowly ovate to lanceolate. In *kerangas* forest………………………….……………………….…………**23. V. parvifolia**
Lateral veins 7–12 pairs; midrib sunken above; leaf blade elliptic to narrowly obovate. In forest on river banks…………………………**32. V. venulosa** (subsp. **venulosa**)

18. Tomentum cream-yellow, caducous; leaf blade at least 2.7 cm wide, broadly elliptic, base cuneate; lateral veins at most 9 pairs; petiole at least 0.5 cm long. In *kerangas* and mixed peat swamp forests……………………………..…**17. V. mangachapoi** (in part)
Tomentum pale greyish brown, not at first caducous; leaf blade at most 2.5 cm wide, narrowly elliptic-lanceolate, base obtuse; lateral veins at least 10 pairs; petiole to 0.4 cm long. In forest on alluvium along river banks……….....**29. V. rynchocarpa** (in part)

19. Petiole, midrib and veins below vinous-cinereous; fresh leaves distinctly bluish green below…………………………………………………………………………….…20
Petiole, midrib and veins below rufous, pinkish brown or pale greyish or yellowish brown tomentose; fresh leaves not bluish green below……………………….......23

20. Twigs at first compressed……………………………………..…**21. V. oblongifolia**
Twigs terete……………………….………………….………………….……..…21

21. Petiole 2–3 mm diameter………………………………..…**25. V. pedicellata** (in part)
Petiole less than 1 mm diameter………………………….…………………..…22

22. Lateral veins 12–20 pairs, slender but more or less prominently raised below. In mixed dipterocarp forest on clay soils, at altitudes to 600 m………………..…**33. V. vinosa**
Lateral veins 10–12 pairs, slender, hardly raised below. Mostly in upper dipterocarp forests on ridges, at altitudes to 1350 m……………….…**10. V. dulitensis** (in part)

23. Tomentum rufous- or pinkish-brown………………………………………….…24
Tomentum cream, pale greyish to yellowish brown, or yellowish…………………..…30

24. Lateral veins 7–13 pairs, without or with a few short intermediate veins; leaf blade broadly ovate, elliptic, lanceolate, oblanceolate or obovate; petiole long, slender…….25
Lateral veins 12–28 pairs, with many intermediate veins; leaf blade narrowly oblong to obovate; petiole short and stout, or long and slender…………………………..…27

25. Lateral veins sharply prominent below; tomentum rufous, flocculent, caducous…………………… **16. V. maingayi** (in part)
    Lateral veins terete below; tomentum even, pinkish brown to pale yellowish brown, persistent……………………26

26. Petiole at least 2 cm long; leaf blade drying rich pinkish brown, glistening…………………… **2. V. badiifolia**
    Petiole at most 2 cm long; leaf blade drying pale greyish brown…….. **26. V. perakensis**

27. Petiole at least 3 mm diameter, stout and short………… **30. V. sarawakensis** (in part)
    Petiole at most 2.5 mm diameter, slender……………………28

28. Tomentum short, even, persistent; lateral veins narrowly grooved above.. **13. V. globosa**
    Tomentum in part flocculent, caducous; lateral veins not grooved above……………29

29. Petiole to 1.2 cm long, hardly geniculate; leaf blade narrowly elliptic-obovate; intermediate and intercostal veins prominent below………………… **15. V. havilandii**
    Petiole to 2 cm long, geniculate; leaf blade narrowly oblong; intermediate and intercostal veins hardly raised below…………………… **20. V. nitens**

30. Lateral veins at least 15 pairs; petiole at least 3 mm diameter……………………31
    Lateral veins less than 15 pairs; petiole less than 3 mm diameter……………………32

31. Petiole more than 2 cm long…………………… **27. V. rassak**
    Petiole shorter than 2 cm…………………… **30. V. sarawakensis** (in part)

32. Leaf blade below densely evenly ochreous sericeous. In *kerangas* forest... **5. V. brunigii**
    Leaf blade below glabrous or sparsely tomentose on venation only. Not in *kerangas* forest……………………33

33. Leaf blade elliptic-obovate……………………34
    Leaf blade ovate, narrowly elliptic, lanceolate, oblong, or obovate-oblong……………38

34. Lateral veins at most 8 pairs; petiole at least 1.5 cm long………… **24. V. patentinervia**
    Lateral veins at least 10 pairs or, if less, then petiole at most 1.1 cm long……………35

35. Leaf blade chartaceous……………………36
    Leaf blade coriaceous to thickly coriaceous……………………37

36. Lateral veins at most 10 pairs…………………… **4. V. brevipes**
    Lateral veins at least 11 pairs…………………… **11. V. endertii**

37. Lateral veins 12–24 pairs; tomentum scabrid………………… **14. V. granulata** (in part)
    Lateral veins 10–13 pairs; tomentum even…………………… **8. V. congesta**

38. Intercostal venation prominent below; lateral veins and midrib below persistently shortly scabrid-pubescent; lateral veins arching and anastomosing to form an intramarginal vein…………………… **19. V. micrantha**
    Intercostal venation not prominent below; lateral veins and midrib glabrescent; lateral veins otherwise……………………39

39. Midrib raised above……………………………………………….…**18. V. maritima**
    Midrib flat or furrowed above…………………………………………….…40

40. Leaf blade larger, 10–20 × 2.7–7 cm, narrowly obovate; twigs angular, peeling in small flakes; lateral veins stoutly prominent below.....................…**14. V. granulata** (in part)
    Leaf blade smaller, 8–16 × 2.7–5.5 cm, narrowly elliptic to ovate; twigs terete; lateral veins slender though raised below……………………………….……**22. V. odorata**

1. **Vatica albiramis** Slooten

(Latin, *albus* = white; *ramis* = twigs; with white twigs)

Bull. Jard. Bot. Buitenz. 3, 9 (1927) 101; Masamune *op. cit.* 498; Meijer & Wood *op. cit.* 305; Ashton *op. cit.* (1964) 66, *op. cit.* (1968) 30, *op. cit.* (1982) 355; Burgess *op. cit.* 227; Anderson *op. cit.* (1980) 131; Coode *et al.* (eds.) *op. cit.* 84. **Type:** *Elmer 21640*, Borneo, Sabah, Tawau district (holotype BO; isotypes KEP (fragment), L).

Subcanopy tree, to 25 m tall, to 35 cm diameter. *Parts glabrous but for caducous puberulent flower calyx and ovary.* **Twigs** *c.* 1 mm diameter apically, slender. **Stipules** hastate, to 16 × 3.5 cm, caducous. **Leaves** thinly coriaceous, drying dull greyish green; blade elliptic to lanceolate, 8–20 × 3–7 cm, base narrowly cuneate, apex with slender acumen to 1.5 cm long; *lateral veins 4–6 pairs*, rather broad, slightly raised on both surfaces though most prominently below, arched and continuing along margin at first; intercostal venation subscalariform; *petiole glabrous*, *drying black*, 1–1.5 cm long. **Inflorescences** to 28 cm long, terminal or axillary, lax. **Flowers:** corolla lemon yellow; other parts as the genus (typical). **Fruits** *calyx lobes free*, *subequal*, *ovate*, *to 1.2 × 0.4 cm*, *obtuse*, *coriaceous*, *glabrous*, *becoming reflexed*. **Nuts** *globose*, *to 1.2 cm diameter*, *smooth*, *fulvous puberulent.*

Vernacular names. Sabah—*resak putih* (preferred name). Sarawak—*resak ranting putih* (Malay).

Distribution. Endemic in Borneo. In Sabah, widespread and known from most districts (e.g., *SAN 15292*, *SAN 27873*, *SAN 36080*, *SAN 60181*, and *SAN 110318*) and in Sarawak recorded from Bintulu, Kapit, Lawas, Marudi, and Miri districts (e.g., *S 18091*, *S 41411*, *S 44632*, *S 57292*, and *S 61052*). Also occurring in Brunei (e.g., *BRUN 3048*, *Dransfield JD 7060* and *FMS 39647*).

Ecology. In mixed and upper dipterocarp forest, on clay-rich soils especially on ridges, at altitudes to 1400 m. Common and probably not vulnerable.

2. **Vatica badiifolia** P.S.Ashton

(Latin, *badius* = chestnut-brown, *folius* = leaf; the dry leaf colour)

Gard. Bull. Sing. 22 (1967) 266, *op. cit.* (1968) 30, *op. cit.* (1982) 367; Anderson *op. cit.* (1980) 131; Coode *et al.* (eds.) *op. cit.* 84. **Type:** *Ilias & Johnson S 15857*, Borneo, Sarawak, Similajau district, Labang FR (holotype K; isotype L). **Synonym:** *Vatica bantamensis auct. non* (Hassk.) Benth. & Hook. *ex* Miq.: Ashton *op. cit.* (1964) 67.

Canopy tree, to 40 m tall, to 50 cm diameter. *Young twig*, *inflorescence*, *leaf bud*, *stipule*, *petiole*, *parts of flower exposed in bud*, *and ovary densely evenly pinkish brown puberulent.* **Twigs** to 3 mm diameter apically, *terete* or ribbed, becoming smooth. **Stipules** hastate, to 5 × 1.5 mm. **Leaves** *thinly coriaceous*, *caducously tomentose below*, *drying rich pinkish brown and frequently glistening*; *blade elliptic*, 7.7–15 × 3–6.5 cm, base cuneate, *margin not revolute*, *apex deltoid-acuminate*, acumen to 0.5 cm long; *lateral veins 9–12 pairs*, arched, stout, *terete and raised on both surfaces though most prominently below*, *without intermediate veins*; intercostal venation prominent below; *petiole 2–3.5 cm long*, *slender*, *not drying black*, distinctly thickened in the distal half and geniculate. **Inflorescences** terminal or axillary, singly or doubly branched, to 8 cm long. **Flowers:** buds to 1.3 cm long; calyx densely shortly cream pubescent; otherwise typical. **Fruits:** pedicels to 5 mm long, slender; *calyx lobes free to the plate-like base around the nut*, *unequal*, *chartaceous*, *2 longer lobes oblong-spatulate*, *to 8 × 2.5 cm*, *constricted to 4 mm wide at base*, *not becoming reflexed*, 3 shorter ones hastate, to 3 × 0.8 cm, similarly constricted. **Nuts** globose, to 0.8 × 0.8 cm, persistently fulvous puberulent; apical style remnant often persisting.

Vernacular name. Sarawak—*resak bantam* (Malay).

Distribution. Endemic in Borneo. In Sarawak recorded from Bintulu, Kuching, Miri, and Tatau districts (e.g., *S 15133*, *S 16492*, *S 24826*, *S 32598*, and *S 46590*). Also occurring in Brunei (e.g., *FMS 39650* and *S 2120*) and W Kalimantan (e.g., *bb. 10596*, *bb. 18312*).

Ecology. Locally frequent, in mixed dipterocarp forest on deep leached soils on coastal hills. Common in Lambir NP; elsewhere endangered by forest conversion.

3. **Vatica borneensis** Burck

(of Borneo)

Ann. Jard. Bot. Buitenz. 6 (1887) 230; Merrill *op. cit.* (1921) 208; Slooten *op. cit.* (1927) 87; Masamune *op. cit.* 498; Browne *op. cit.* 100; Ashton *op. cit.* (1964) 68, *op. cit.* (1968) 30, *op. cit.* (1982) 363; Anderson *op. cit.* (1980) 131; PROSEA *op. cit.* 465; Coode *et al.* (eds.) *op. cit.* 84. **Type:** *Beccari PB 2623*, Borneo, Sarawak, Matang (BO). **Synonyms:** *Vatica urbanii* F.Heim, Bull. Mens. Soc. Linn. Paris 2 (1891) 956; *Sunaptea urbanii* (F.Heim) F.Heim, Rech. Dipt. (1892) 115; *S. borneensis* (Burck) F.Heim *op. cit.* (1892) 116.

Canopy tree, to 35 m tall, to 70 cm diameter. *Young twig*, *inflorescence*, *parts of flower exposed in bud*, *ovary*, *midrib below*, *and petiole densely evenly pinkish brown puberulent*, *more or less persistent*. **Twigs** *c.* 1.5 mm diameter apically, slender, *terete or ribbed*, smooth or rugulose. **Stipules** unknown. **Leaves** *coriaceous*, *drying dull pale pinkish brown*; *blade elliptic*, 6–10 × 2.5–5 cm, base cuneate, *margin not revolute*, *apex acuminate*, acumen to 0.6 cm long; midrib prominent below, almost flat above; *lateral veins 7–9 pairs*, arched, *distinct but hardly and subequally raised on both surfaces* as also the intercostal veins; *petiole 1.5–2.5 cm long*, *slender*, hardly or not swollen distally, *not drying black*. **Inflorescences** axillary, to 5 cm long. **Flowers:** buds to 1 cm long, densely pinkish brown pubescent; otherwise typical. **Fruits:** pedicels *c.* 5 mm long, slender; calyx glabrescent, *lobes free*, *unequal*, *chartaceous*, *2 longer lobes oblong-spatulate*, *to 5.5 × 1.5 cm*, *to 0.4 cm wide at base*, *not becoming reflexed*, 3 shorter ones unequal, narrowly ovate, tapering, to 1.8 × 0.7 cm. **Nuts** globose, to 1 cm diameter, smooth, glabrescent, with persisting style remnant.

Vernacular name. Sarawak—*resak kemudi* (preferred name).

Distribution. Endemic in Borneo; recorded in Sarawak from Bau, Bintulu, Kuching, Lundu, and Simunjan districts (e.g., *S 6360*, *S 17877*, *S 19576*, *S 27136*, and *S 66788*). Also occurring in Brunei (e.g., *S 2134* and *SAN 17545*).

Ecology. Locally common, more often scattered, in mixed dipterocarp forest on poor yellow sandy soils; also in upper dipterocarp forest on coastal sandstone hills and, occasionally, inland ridges, at altitudes to 900 m. Locally common in Bako NP; elsewhere endangered.

4. **Vatica brevipes** P.S.Ashton

(Latin, *brevis*=short, *pes*= foot; the short petiole)

Gard. Bull. Sing. 31 (1978) 24, *op. cit.* (1982) 366. **Type:** *Othman S 29633*, Borneo, Sarawak, Kapit district, Ulu Baleh (holotype K; isotype KEP).

Main canopy or subcanopt tree, to 25 m tall, 30 cm diameter. *Buds*, *petioles and inflorescences densely persistently pale brown scabrid-puberulent*; *parts of corolla exposed in bud and ovary evenly so*; *sepals caducously evenly so*; *parts otherwise glabrous*. **Twigs** rugose and ribbed, becoming flaky, *terete*, dark brown, *c.* 2 mm diameter apically. **Leaves** *chartaceous*, *glabrous*, more or less concave between the lateral veins; *blade elliptic to obovate*, (4–)5–13 × (1.5–)2–5(–5.5) cm, *base narrowly cuneate*, *margin not revolute*, *apex with short*, *slender acumen to 0.6 cm long*; midrib slender, sharply raised on both surfaces; *lateral veins 7–10 pairs*, ascending, straight at first, arching and forming intermittent intramarginal connections, *slender but prominent below*, *elevated above*, with a few short intermediates; intercostal venation distantly reticulate, evident on both surfaces though more so below; *petiole* somewhat stout, *0.5–1.1 cm long*, *not drying black*. **Inflorescences** *axillary or terminal*, to 1.6 cm long; rachis very slender, hardly branched. **Flower:** buds ellipsoid, to 3 × 2 mm; otherwise typical. **Fruits:** pedicel slender, to 6 mm long; *calyx lobes unequal free*, *2 longer lobes spatulate*, *subacute or obtuse*, *to 5 × 1.4 cm*, *not becoming reflexed*, 3 shorter ones lanceolate, acute, to 1.2 × 0.3 cm. **Nuts** subglobose, to 0.8 cm diameter, apiculate.

Distribution. Endemic in Borneo. Known in Sarawak from Kapit district (e.g., *S 23943*, *S 29576* and *S 41495*). Also occurring in W Kalimantan (e.g., *Suzuki K 9766*).

Ecology. Apparently uncommon, in mixed and upper dipterocarp forest on clay soils over sedimentary rock, at altitudes between 250–1300 m. Vulnerable.

5. **Vatica brunigii** P.S.Ashton

(E.F.W.O. Brunig, forester in Sarawak and Brunei, 1954–1964)

Gard. Bull. Sing. 22 (1967) 267, *op. cit.* (1968) 30, *op. cit.* (1982) 362; Anderson *op. cit.* (1980) 131; Coode *et al.* (eds.) *op. cit.* 84. **Type:** *Ilias S 17045*, Borneo, Sarawak, Samarahan district, Sabal FR (holotype K; isotypes KEP, L).

Canopy tree, to 30 m tall, to 70 cm diameter. *Living exposed parts and ovary*, *leaf above excepted*, *persistently shortly yellowish buff scabrid-pubescent*; *leaf above fugaceous flocculent pubescent*. **Twigs** *c.* 2 mm diameter apically, *terete*. **Stipules** lorate, to 5 × 2 mm, obtuse. **Leaves** *thinly coriaceous*, *persistently ochreous pubescent below*; *blade ovate-elliptic to obovate*, 6–12 × 2.5–6.5 cm, base cuneate to obtuse, *margin not revolute*, *apex acuminate with tapering acumen to 1 cm long*; *lateral veins 9–12 pairs*, *unraised above*, *slender but prominent below as also the midrib and subscalariform intercostal venation*; *petiole* 0.8–1.5 cm long, *to 3 mm diameter*, *not drying black*. **Inflorescences** terminal or axillary towards twig endings; rachis singly or doubly branched, to 12 cm long. **Flowers** distichous; buds ellipsoid, to 8 × 2 mm; sepals densely ochreous-grey pubescent; petals narrowly oblong, sparsely pubescent outside, glabrescent within. **Fruits:** pedicels to 3 mm long, slender; *calyx lobes unequal*, *free*, *chartaceous*, *2 longer lobes lorate to spatulate*, *to 6.5 × 1.5 cm*, *not becoming reflexed*, 3 shorter ones ovate, acute, slightly recurved, to 1.5 × 0.6 cm. **Nuts** ovoid, to 0.9 × 0.7 cm, subacute.

Distribution. Sumatra and Borneo. In Sarawak known from Bintulu, Kuching, Limbang, Lundu, Marudi, Samarahan, and Simunjan districts (e.g., *S 1484*, *S 6437*, *S 8256*, *S 17885*, and *S 69059*). Also occurring in Brunei (e.g., *S 1011* and *S 12352*) and W Kalimantan (e.g., *Church et al. 987*).

Ecology. In *kerangas* forests, both on raised beaches and dry sandstone plateaux and cuestas, at altitudes to 700 m. Occurring in Bako and Mulu NPs; elsewhere critically endangered by forest conversion.

6. **Vatica chartacea** P.S.Ashton

(Latin, *chartaceus* = papery; the leaf blade)

Gard. Bull. Sing. 31 (1978) 18, *op. cit.* (1982) 351. **Type:** *Leopold SAN 46204*, Borneo, Sabah, Labuk Sugut district, Sapi FR (holotype K; isotype SAN).

Medium-sized tree. *Young parts buff puberulent*, *caducous except on parts exposed in bud and ovary*. **Twigs** *c.* 2 mm diameter apically, much-branched. **Stipules** lanceolate, to 7 × 2 mm, caducous. **Leaves** *thinly chartaceous*, drying wrinkled and pale yellowish brown; *blade oblong to obovate*, *11–25 × 3–10 cm*, base broadly cuneate to obtuse, *apex acuminate with prominent acumen to 1 cm long*; *lateral veins 16–20 pairs*, *with short slender intermediates*, slender but prominent below, distinctly elevated above as also the midrib, arched; intercostal venation subscalariform, sinuate, elevated on both surfaces; *petiole 1–2.2 cm long*, *slender*, *drying black*, *glabrous*. **Inflorescences** to 5 cm long, in axillary cluster of 3, stout. **Flowers:** buds spindle-shaped, to 6 × 2 mm; sepals subequal, lanceolate; otherwise typical. **Fruits:** pedicels to 6 mm long, slender; *calyx revolute*, *lobes subequal*, *chartaceous*, *free*, *lanceolate*, *cordate*, *subacute*, *5–7-veined*, *to 6 × 1.5 cm*, *ascending and conceiling the nut*. **Nuts** ellipsoid, to 1.3 × 1.1 cm.

Distribution. Endemic in Borneo. In Sabah recorded from Kinabatangan, Kudat, Lahad Datu, Pensiangan, and Sandakan districts (e.g., *SAN 17654*, *SAN 18397*, *SAN 25451*, *SAN 57046*, and *SAN 97326*) and in Sarawak from Bintulu and Miri districts (e.g., *S 15808*, *S 40177* and *S 60537*). Also in W Kalimantan (e.g., *bb. 35244* and *bb. 35257*).

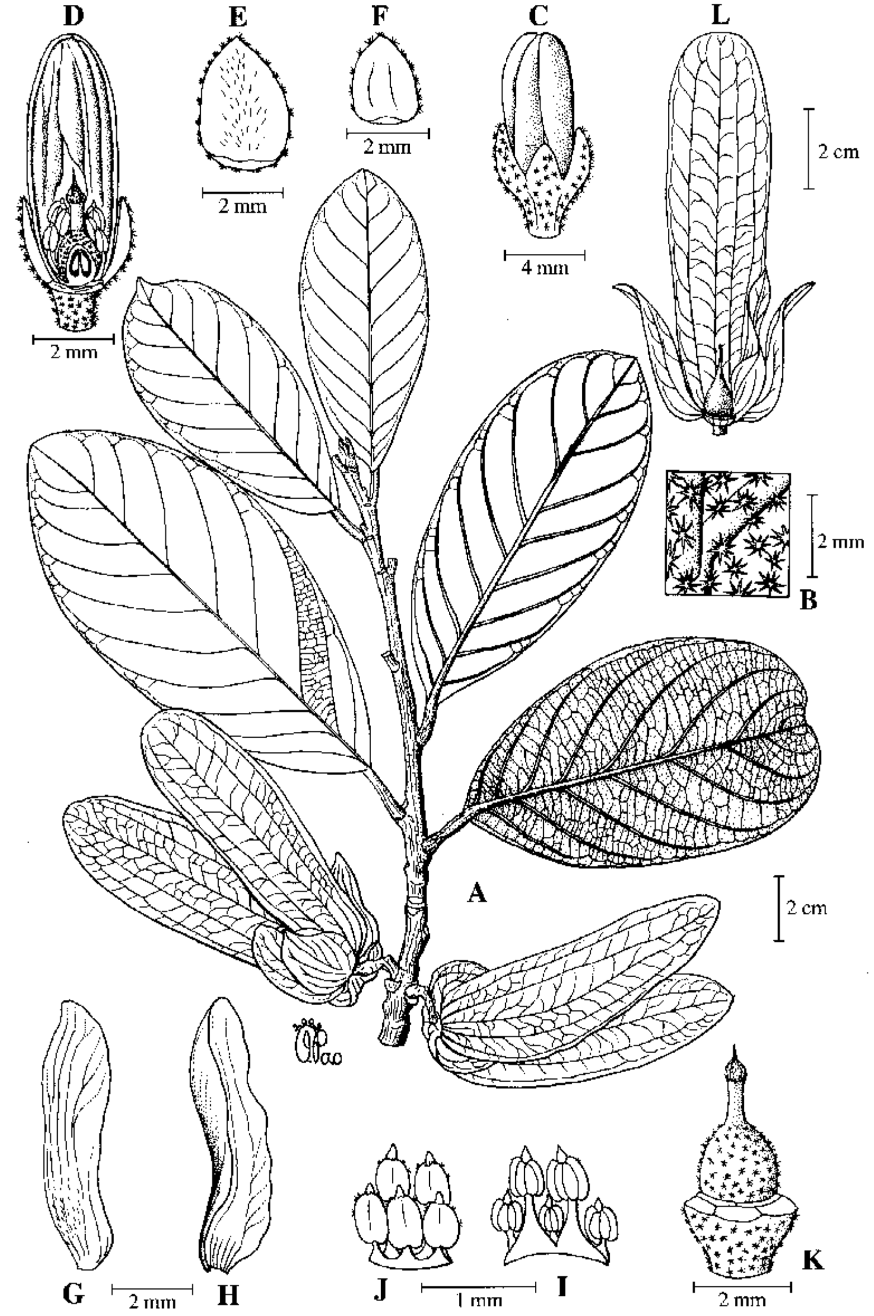

Fig. 33. *Vatica congesta*. A, fruiting leafy twig; B, detail of indumentum on lower leaf surface; C, flower bud; D, longitudinal section of flower bud; E, adaxial view of outer sepal; F, adaxial view of inner sepal; G, abaxial view of petal; H, adaxial view of petal; I, adaxial view of stamens; J, abaxial view of stamens; K, gynoecium; L, fruit with exposed nut. (A–B from *S 29474*, C–K from *S 15021*, L from *S 9347A*.)

Ecology. Very local, in forest on floodplains and alluvium banks of sluggish rivers. Critically endangered owing to land conversion.

7. **Vatica compressa** P.S.Ashton

(Latin, *compressus* = compressed; the young twig)

Gard. Bull. Sing. 22 (1967) 267, *op. cit.* (1968) 30, *op. cit.* (1982) 361; Anderson *op. cit.* (1980) 131. **Type:** *Daud & Tachun SFN 35618*, Borneo, Sarawak, Setapok Forest (holotype KEP; isotypes KEP, L).

Canopy tree, to 30 m tall, to 35 cm diameter. *Exposed young parts and ovary pale pinkish brown pubescent, caducous except on leaf bud and stipules.* **Twigs** at first *c.* 3 × 1 mm apically, *compressed*, smooth; stipule scars pale, horizontal, prominent. **Stipules** *not seen.* **Leaves** coriaceous; blade ovate-elliptic, 11–19 × 5–8.5 cm, base obtuse, apex with acumen to 1 cm long; midrib prominent below, flat or elevated above; *lateral veins 10–15 pairs*, with short indistinct intermediates, *slender and hardly elevated on either surface though more so below*, arched; intercostal venation subscalariform; *petiole* 1.5–2.3 cm long, slender, *not drying black*. **Inflorescences** to 7 cm long; rachis somewhat compressed, irregularly singly or doubly branched. **Flowers:** buds lanceolate, to 9 × 4 mm; otherwise typical. **Fruits:** pedicels to 8 mm long, slender; *calyx lobes free*, *unequal*, *chartaceous*, *2 longer lobes lorate*, *obtuse*, *to 6.5 × 1 cm*, *tapering to 3 mm wide at base*, 3 shorter ones deltoid, acute, revolute, to 2 × 0.6 cm. **Nuts** broadly ovoid, to 0.5 cm diameter, with to 3 mm filiform style remnant.

Distribution. Endemic in Borneo. Confined to Sarawak, and recorded from Kuching, Lundu, and Sri Aman districts (e.g., *S 5984*, *S 6604*, *S 13275*, and *S 49944*).

Ecology. Rare and local, in *kerangas* forest, apparently at least sometimes with impeded drainage. Critically endangered, possibly extinct.

8. **Vatica congesta** P.S.Ashton Fig. 33.

(Latin, *congestus* = heaped together; the inflorescences)

Gard. Bull. Sing. 22 (1967) 268, *op. cit.* (1968) 31, *op. cit.* (1982) 362; Anderson *op. cit.* (1980) 131. **Type:** *Yakup S 9347A*, Borneo, Sarawak, Kuching district, Semengoh FR (holotype K; isotypes KEP, L, SAR).

Suncanopy or canopy tree, to 35 m tall, to 35 cm diameter. *Exposed fleshy parts mostly densely shortly pale ochreous brown scabrid-pubescent*; *leaf blade below and midrib towards base above sparsely so*; *leaf blade above glabrescent*; *parts otherwise persistently so*. **Twigs** *c.* 3 mm diameter apically, stout, *at first terete*, rugose, becoming striated and thinly flaky. **Stipules** deltoid, to 8 × 3 mm, acute. **Leaves** *thickly coriaceous*, *glabrous*, drying pale tawny brown; blade oblong, elliptic to obovate, 8–22 × 3.5–8 cm, base obtuse, *margin revolute*, *apex obtuse to retuse*; *lateral veins 10–13 pairs*, *prominent and stout below*, elevated above, as also the midrib; intercostal venation reticulate, similarly raised; *petiole 1.2–2.5 cm long*, *to 3 mm diameter*, stout, rugulose, *not drying black*. **Inflorescences** *axillary to ramiflorous*, *fascicled*; rachis angular, *to 3 cm long*, *short and congested*, *singly branched*. **Flowers** distichous; buds to 8 × 3 mm; sepals deltoid-acute; petals lorate-obtuse; otherwise typical. **Fruits:** pedicels to 4 mm long, scabrid-pubescent, fruit otherwise glabrous; *calyx lobes free*, *unequal*, *chartaceous*, *2 longer lobes lorate*, *obtuse*, *to 12 × 2.2 cm*, *not becoming reflexed*, 2 shorter ones narrowly ovate, to 4.5 × 1.5 cm, tapering, acute, recurved. **Nuts** ellipsoid, to 1.2 × 0.8 cm, with to 6 mm style remnant, glabrous.

Distribution. Endemic in Borneo. Known in Sarawak from Belaga and Kuching districts (e.g., *S 14936*, *S 15713*, *S 29476*, *S 32501*, and *S 56979*). Also occurring in W Kalimantan.

Ecology. Very local but frequent where it occurs, in mixed dipterocarp forest on poor sandy clay soil. Endangered.

9. **Vatica coriacea** P.S.Ashton

(Latin, *coriaceus* = leathery; the leaf texture)

Gard. Bull. Sing. 22 (1962) 314, *op. cit.* (1964) 68, *op. cit.* (1968) 31, *op. cit.* (1982) 362; Anderson *op. cit.* (1980) 131; PROSEA *op. cit.* 465; Coode *et al.* (eds.) *op. cit.* 84. **Type:** *Ariffin S 372*, Borneo, Sarawak, Lundu district, Bt. Sebandar (holotype K; isotype KEP).

Canopy tree, to 20 m tall, to 50 cm diameter. *Exposed young parts densely shortly ochreous puberulent*, *glabrescent except on buds.* **Twigs** to 5 mm diameter apically, *terete*, stout, ribbed. **Stipules** hastate, to 13 × 5 mm, subacute. **Leaves** *thickly coriaceous*, *drying tawny-brown to dark brown*; *blade narrowly obovate*, 6.5–15 × 2.2–6 cm, *concave*, base narrow, obtuse or cuneate, *margin revolute*, *apex obtuse to retuse*; midrib stoutly prominent below, slightly raised above; *lateral veins 10–11 pairs*, with short slender intermediates, *slightly and more or less equally elevated on both surfaces*, arched; intercostal venation reticulate; *petiole 1–1.5 cm long*, *stout*, *drying black or not.* **Inflorescences** axillary or terminal; rachis *to 20 cm long*, singly branched, often bearing small modified leaves at branch bases. **Flowers** to 18 mm long; calyx densely shortly pale greyish brown pubescent; otherwise typical. **Fruits:** pedicels to 7 mm long, slender; *calyx lobes free to base*, *unequal*, *chartaceous*, *2 longer lobes oblong*, *obtuse*, *to 7 × 2.3 cm*, *tapering to 3.5 mm broad at base*, *not becoming reflexed*, 3 shorter ones hastate, acute, to 0.6 × 0.2 cm. **Nuts** globose, to 0.8 cm diameter, style remnant to 2 mm long.

Vernacular name. Sarawak—*resak daun tebal* (preferred name).

Distribution. Endemic in Borneo. In Sabah, known from a single collection from Tawai Plateau, Kinabatangan district (*SAN 39325*) and in Sarawak known from Kuching and Lundu districts (e.g., *S 6344*, *S 10296*, *S 15607*, and *S 15798*). Also occurring in Brunei (e.g., *BRUN 3155* and *BRUN 5652*) and C Kalimantan (e.g., *Suzuki K 11483*).

Ecology. Locally common, in *kerangas* forest on giant humic podsols on Pleistocene raised beaches, and on organic soils over limestones. Well represented in Bako NP and recorded from Mulu NP; endangered outside parks system.

10. **Vatica dulitensis** Symington

(of G. Dulit, Sarawak)

Gard. Bull. S. S. 8 (1934) 35; Masamune *op. cit.* 498; Browne *op. cit.* 100; Ashton *op. cit.* (1964) 69, *op. cit.* (1968) 31, *op. cit.* (1982) 356; Meijer & Wood *op. cit.* 308; Burgess *op. cit.* 227; Anderson *op.*

cit. (1980) 131; PROSEA *op. cit.* 466; Coode *et al.* (eds.) *op. cit.* 84. **Type:** *Richards 1343*, Borneo, Sarawak, G. Dulit (holotype K).

Subcanopy to small canopy tree, to 30 m tall, to 50 cm diameter. *Exposed fleshy parts including petiole and leaf venation below dark vinous-sericeous*, *persistent except on venation*. **Twigs** *terete*, to 1 mm diameter apically, very slender, much-branched. **Stipules** narrowly hastate, to 3 × 1 mm, acute, deciduous. **Leaves** thinly coriaceous, drying pale greyish brown; blade narrowly obovate to lanceolate, 4–11 × 0.8–3.2 cm, *base cuneate*, apex caudate, acumen to 1.5 cm long; *lateral veins 10–12 pairs*, with short slender intermediates, *slender*, *hardly raised below*, arched; intercostal venation reticulate, evident but hardly raised; petiole 0.6–1 cm long, *to 1 mm diameter*, *slender*, *not drying black*. **Inflorescences** terminal or axillary; rachis singly or doubly branched, to 2.5 cm long. **Flowers:** buds to 6 mm long; sepals densely vinous-sericeous; petals cream; otherwise typical. **Fruits:** pedicels to 3 mm long, slender; *calyx lobes chartaceous*, *free*, *equal*, *oblong-obtuse*, *to 1.4 × 0.5 cm*, *vinous caducous cinereous within only*, *becoming rotate to reflexed*. **Nuts** *globose*, *to 0.8 cm diameter*, *smooth*, *vinous cinereous*, with short style remnant.

Vernacular names. Sabah—*resak bukit* (preferred name). Sarawak—*resak tiong* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Beaufort, Kota Belud, Labuk Sugut, Lahad Datu, Ranau, and Sipitang districts (e.g., *SAN 16267*, *SAN 26712*, *SAN 76253*, *SAN 78171*, and *SAN 116860*) and in Sarawak from Belaga, Kapit, Kuching, Lawas, Limbang, Lundu, Marudi, Miri, and Tatau districts (e.g., *S 10184*, *S 14770*, *S 17738*, *S 36093*, and *S 43570*). Also occurring in Brunei (e.g., *BRUN 3042* and *BRUN 3156*) and NE and E Kalimantan (e.g., *Kostermans 9095* and *Kostermans 9248*).

Ecology. Local but often abundant on high ridges on shallow organic soil, in upper dipterocarp forest, at 600–1350 m altitude, and occasionally in lowland mixed dipterocarp forest on leached clay soils. Occurring in G. Gading and Mulu NPs; elsewhere vulnerable.

11. **Vatica endertii** Slooten

(F.H. Endert, 1891–1953, Dutch forester in Indonesia)

Bull. Jard. Bot. Buitenz. 3, 18 (1942) 248; Ashton *op. cit.* (1968) 32, *op. cit.* (1982) 366; Anderson *op. cit.* (1980) 131. **Type:** *Endert 2775*, Borneo, Kalimantan, W Kutei, Long Hoet (holotype BO; isotype L).

Canopy tree, to 30 m tall, to 60 cm diameter; bole sinuous. *Exposed young parts shortly pale brown caducous scabrid-puberulent*, *more or less persistent on inflorescence and sometimes on veins below*; *densely persistently so on ovary*; *parts otherwise glabrous*. **Twigs** *terete*, *c.* 1 mm diameter apically, much-branched, at first striated. **Stipules** not seen. **Leaves** *chartaceous*, drying pale buff-brown; *blade narrowly obovate*, *oblong or rarely lanceolate*, *4.8–14 × 1.7–5.5 cm*, *base cuneate*, *margin not revolute*, *apex acuminate with slender acumen to 1 cm long*; *lateral veins 11–14 pairs*, without intermediates, *prominent below*, *unraised above as also the midrib*; intercostal venation subscalariform; *petiole 0.8–2 cm long*, *not drying black*. **Inflorescences** *terminal or axillary*, *not fascicled*; rachis singly branched, striated, to 3 cm long. **Flowers** typical. **Fruits:** pedicels to 8 mm long, slender; *calyx lobes unequal*, *free*, *chartaceous*, *2 longer lobes oblong-spatulate*, *obtuse*, *to 8 × 2* *cm*, *not becoming reflexed*, *c.* 3 mm wide at base, 3 shorter ones lanceolate, to 2 × 0.6 cm, acute, hardly recurved. **Nuts** subglobose, to 0.6 × 0.5 cm.

Distribution. Endemic in Borneo. Known in Sarawak from Kapit and Miri district (e.g., *S 14383*, *S 19036* and *S 19037*). Also occurring in E Kalimantan (e.g., the type).

Ecology. Scattered, local, in upper dipterocarp forest on acid volcanic rock (dacite) in Sarawak, occasionally also in lowland mixed dipterocarp forest in Kalimantan. Vulnerable owing to logging.

12. **Vatica glabrata** P.S.Ashton

(Latin, *glabratus* = smooth-skinned; the plant parts)

FM 1, 9 (1982) 370; Coode *et al*. (eds.) *op. cit.* 84. **Type:** *Tong S 36852*, Borneo, Sarawak, Marudi district, Dulit Range (holotype K).

Canopy tree, to 20 m tall, to 60 cm diameter. *Buds and ovary densely persistently ochreous puberulent*, *young parts fugaceously so*; *parts otherwise glabrous*, *more or less shiny.* **Twigs** *terete*, *c.* 2 mm diameter apically, smooth. **Stipules** elliptic, obtuse, to 12 × 8 mm, not at first caducous, leaving a falcate scar. **Leaves** *coriaceous*, *more or less concave*, *shiny*, *drying yellowish brown*; *blade lanceolate*, 6–15(–22) × (2–)2.5–7 cm, base obtuse, *margin not revolute*, *apex acuminate with prominent*, *attenuate acumen to 1.5 cm long*; *midrib flat or raised above*; *lateral veins 9–11 pairs*, with more or less short intermediates, ascending, slender, *raised on both surfaces but more so below*; intercostal venation reticulate, distinctly raised on both surfaces; *petiole 1–4 cm long*, *slender*, *prominently geniculate glabrescent*, *drying black.* **Inflorescences** 1–several axillary or terminal; rachis to 7 cm long. **Flowers** typical. **Fruits:** *calyx lobes unequal*, *free*, *chartaceous*, *not becoming reflexed.*

Distribution. Endemic in Borneo. In Sarawak known from Kapit and Marudi districts (e.g., *S 34842*, *S 34865* and *S 36383*). Also occurring in Brunei (e.g., *BRUN 2526* and *BRUN 2533*).

Ecology. Local but frequent, at the upper limits of upper dipterocarp forest, at 1200–1500 m altitude. One sterile and aberrant collection (*S 27283*) from the karst pinnacles on G. Subis, Niah, at altitude *c.* 600 m. Vulnerable.

13. **Vatica globosa** P.S.Ashton

(Latin, *globosus* = spherical; the nut)

Gard. Bull. Sing. 22 (1967) 269, *op. cit.* (1968) 32, *op. cit.* (1982) 358; Anderson *op. cit.* (1980) 132. **Type:** *Ashton S 18091*, Borneo, Sarawak, Labang, Ulu Stirau (holotype K; isotype L).

Subcanopy tree, to 20 m tall, 20 cm diameter. *Exposed fleshy parts and ovary*, *including entire fruit but not leaf blade and venation*, *densely persistently rufous-brown sericeous.* **Twigs** *c.* 2 mm diameter apically, terete. **Stipules** unknown. **Leaves** thinly coriaceous, usually somewhat concave between the lateral veins, *drying greyish to pinkish brown*; *blade obovate*, *7–18 × 3–6.5 cm*, base narrowly cuneate, apex caudate, acumen to 2 cm long; midrib prominent on both surfaces; *lateral veins 12–16 pairs*, *with many intermediate veins*, *slender but prominent below narrowly grooved above*; intercostal venation reticulate; *petiole 0.7–1.5 mm long*, *slender*, *to 2.5 mm diameter*, with distinct adaxial furrow, *rugulose and not black on drying*. **Inflorescences** terminal or 1–several axillary, congested; rachis to 3 cm long. **Flowers:** buds lanceolate, to 5 × 2 mm; calyx densely vinous pubescent outside, glabrous within; corolla sparsely so; otherwise typical. **Fruits:** *calyx lobes equal*, *free*, *oblong*, *obtuse*, *to 0.4 × 0.3 cm*, *reflexed*, *not conceiling the nut*. **Nuts** *globose*, *to 2 cm diameter*, 3-sutured.

Distribution. Endemic in Borneo. In Sarawak recorded from Bintulu, Kapit, Kuching, Marudi, Miri, and Sri Aman districts (e.g., *Haviland & Hose 3159*, *S 14485*, *S 23751*, *S 42461*, and *S 64531*). Also occurring in W Kalimantan (e.g., *bb. 13931*).

Ecology. Locally frquent in mixed dipterocarp forest on yellow sandy clay soils, on low hills including the Arip rhyolite. Endangered by forest conversion.

14. **Vatica granulata** Slooten

(Latin, *granulatus* = appearing like tiny seeds; the nut surface)

Bull. Jard. Bot. Buitenz. 3, 9 (1927) 112, Bull. Jard. Bot. Buitenz. 3, 17 (1941) 136; Masamune *op. cit.* 498; Ashton *op. cit.* (1964) 70, *op. cit.* (1968) 32, *op. cit.* (1978) 21, *op. cit.* (1982) 354; Anderson *op. cit.* (1980) 132; PROSEA *op. cit.* 466; Coode *et al.* (eds.) *op. cit.* 84. **Type:** *Hallier 3399*, Borneo, W Kalimantan, G. Amai Ambit (holotype BO; isotype L).

Canopy tree, to 30 m tall, to 70 cm diameter. *Exposed fleshy parts including leaf venation below but not blade more or less densely shortly yellowish brown scabrid-pubescent*; *persistent except on venation*. **Twigs** *c.* 3 mm diameter apically, stout, *angular*, *papery flaky*. **Stipules** hastate, subacute, to 6 × 4 mm, caducous or oblong-lanceolate and acute to 30 × 20 mm, not at first caducous. **Leaves** *coriaceous*; *blade narrowly obovate-oblong or elliptic-obovate*, *10–20 × 2.7–7 cm*, base narrowly obtuse, apex with tapering acumen to 0.6 cm long; *midrib furrowed above*; *lateral veins 12–14*(*–24*) *pairs*, *prominent below*, *slightly sunken above*, *well-spaced*; *intercostal venation indistinct below*, *petiole 1.2–2 cm long*, *to 3 mm diameter*, *drying not black*. **Inflorescences** variable. **Fruits** subsessile; *calyx lobes free*, *subequal*, *chartaceous*, *deltoid*, *brittle*, *glabrous*, *reflexed*, *to 0.7 × 0.4 cm* or elliptic, revolute, to 2 × 1.2 cm. **Nuts** *ovoid*, *to 3.5 × 4 cm*, acute or subacute, *coarsely granulate*, 3-furrowed.

Vernacular name. Sarawak—*resak ranting bersisik* (preferred name).

Distribution. Endemic in Borneo.

Ecology. In upper dipterocarp forest, on high ridges, at altitude between 500–1700 m.

Notes. Two subspecies, *viz.* subsp. *granulata* and subsp. *sabaensis*, are recognised in Sabah and Sarawak.

Key to subspecies

Stipules hastate, subacute, to 6 × 4 mm, soon caducous. Inflorescence to 3 cm long, axillary. Fruit calyx lobes deltoid, not revolute, to 0.7 × 0.4 cm...

subsp. **granulata**

Locally abundant in its suitable habitat. In Sabah recorded from Keningau and Tambunan districts (e.g., *SAN 115452* and *Wong WKM 2646*) and in Sarawak from Bau, Belaga, Kapit, Kuching, Marudi, Serian, and Tatau districts (e.g., *S 15217*, *S 17658*, *S 22221*, *S 36347*, and *S 60381*). Also occurring in Brunei (e.g., *BRUN 2641* and *FMS 30578*) and W Kalimantan (e.g., *Argent et al. 93156* and the type). Occurring in Mulu NP; probably not vulnerable.

Stipules oblong-lanceolate, acute, to 30 × 20 mm, not at first caducous. Inflorescence to 15 cm long, lax, terminal or axillary. Fruit calyx lobes elliptic, revolute, to 2 × 1.2 cm………...

subsp. **sabaensis** P.S.Ashton

(of Sabah)

Gard. Bull. Sing. 31 (1978) 21, *op. cit.* (1982) 354; PROSEA *op. cit.* 466. Type: *G.H.S. Wood & Kilang SAN 16613*, Borneo, Sabah, Sipitang, Bt. Batanga north slope (holotype K; isotypes KEP, SAN). Synonym: *V. scortechinii auct. non* (King) Brandis: Meijer & Wood *op. cit.* 319.

Known in Sabah from Kota Belud, Labuk Sugut, Lahad Datu, Ranau, and Sipitang districts (e.g., *SAN 16708*, *SAN 17000* and *SAN 130634*) and in Sarawak from Limbang and Marudi districts (e.g., *Nooteboom & Chai 2233*, *S 37286* and *S 44403*). Also occurring in Brunei (e.g., *Prance 30578*) and E Kalimantan (e.g., *Kostermans 7465*). In upper dipterocarp forest, at altitudes to 1700 m. Occurring in Kinabalu NP; probably not vulnerable.

15. **Vatica havilandii** Brandis Fig. 34.

(G.D. Haviland, 1857–1901, surgeon and naturalist in Sarawak)

J. Linn. Soc. Bot. 31 (1895) 133; Merrill *op. cit.* (1921) 409; Slooten *op. cit.* (1927) 95; Masamune *op. cit.* 498; Symington, J. Malay. Br. Roy. As. Soc. 19 (1941) 155, Malay. For. Rec. 16 (1943) 220; Browne *op. cit.* 100; Ashton *op. cit.* (1964) 71, *op. cit.* (1968) 33, *op. cit.* (1982) 351; Anderson *op. cit.* (1980) 132; PROSEA *op. cit.* 467; Coode *et al.* (eds.) *op. cit.* 85. **Type:** *Haviland 1848*, Borneo, Sarawak, near Kuching (holotype K).

Small to medium-sized tree, occasionally to 30 m tall, to 30 cm diameter. *Exposed fleshy parts but for leaf blade and ovary densely persistently deep fulvous-brown flocculent tomentose*; *indumentum glabrescent on fruit calyx lobes*, *sparse and early caducous on leaf venation below.* **Twigs** to 2.5 mm diameter apically, terete or slightly compressed, smooth or slightly flaky. **Stipules** linear, to 12 × 2.5 mm, caducous. **Leaves** thinly coriaceous, more or less bullate between lateral veins, drying reddish brown; *blade narrowly obovate-oblong*, *8–17 × 2.5–5 cm*, base cuneate, apex with slender acumen to 1 cm long; midrib terete, prominent below, flat or somewhat elevated above; *lateral veins 15–20 pairs*, *with prominent short intermediates*, *slender*, arched towards margin, *flat to slightly raised above*, *prominent below*; *petiole 1–1.2 cm long*, *to 2.5 mm diameter*, *hardly geniculate*, *not drying black*. **Inflorescences** terminal or axillary; rachis terete, singly branched, to 8 cm long. **Flowers:** buds to 5 mm long; calyx densely rust-brown powdery tomentose; otherwise typical. **Fruits** pedicels to 5 mm long, hidden within calyx; *calyx lobes subequal*, *free*, *chartaceous*, *ovate*, *acute*, *cordate*, *revolute*, *to 2.5 × 1.5 cm*. **Nuts** globose, to 1.2 cm diameter, *conceiled within calyx.*

Vernacular name. Sabah and Sarawak—*resak degong* (preferred name).

Distribution. Peninsular Malaysia and Borneo. In Sabah recorded from Sandakan district (e.g., *SAN 36684*, *SAN 37880* and *SAN 79480*) and in Sarawak from Kuching, Mukah and

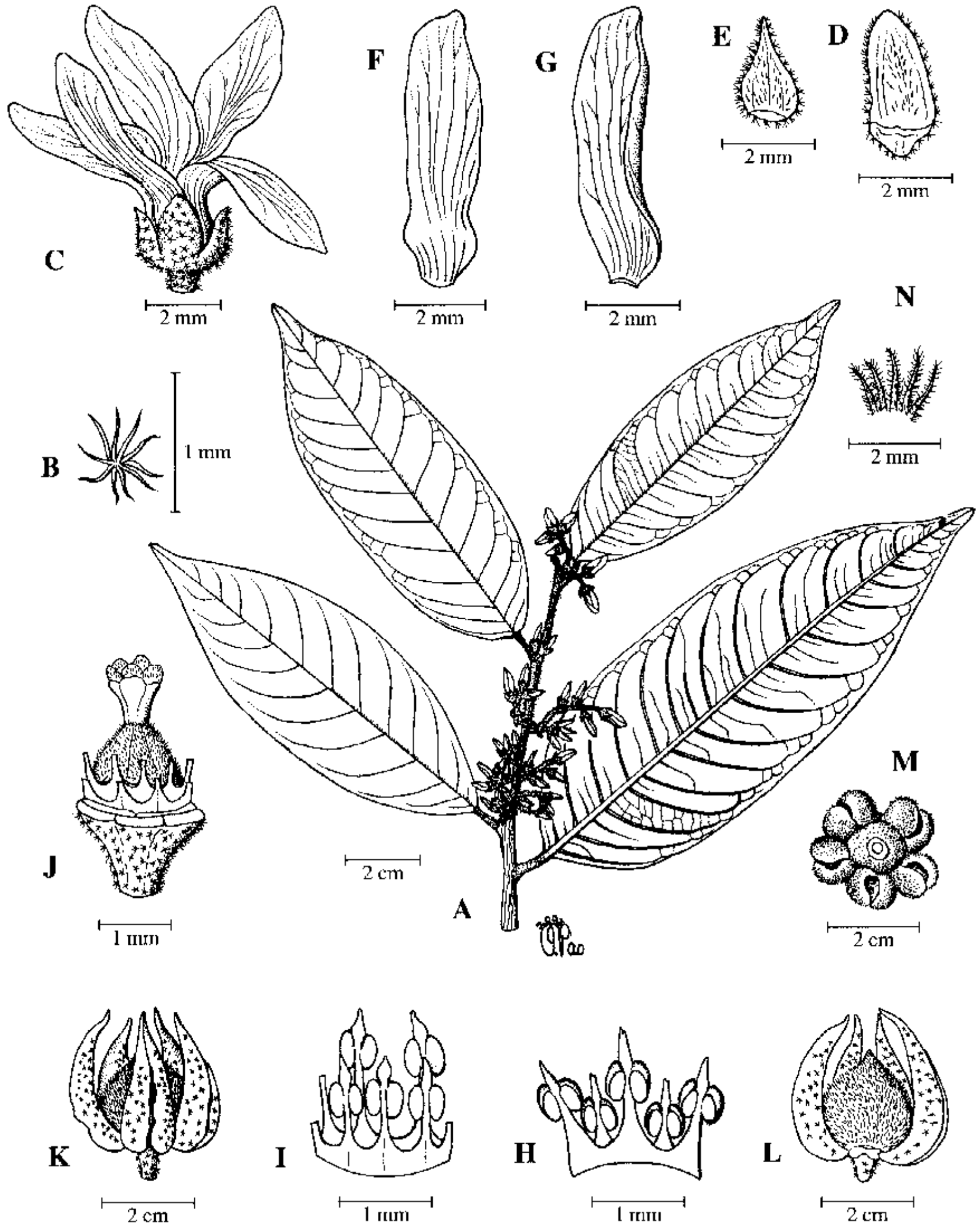

Fig. 34. *Vatica havilandii.* A, flowering leafy twig; B, tufted hair; C, open flower; D, adaxial view of outer sepal; E, adaxial view of inner sepal; F, abaxial view of petal; G, adaxial view of petal; H, adaxial view of stamens; I, abaxial view of stamens; J, gynoecium; K, fruit; L, fruit with exposed nut; M, basal view of fruit; N, hairs on nut. (A–J from *SAN 36684*, K–N from *S 23244*.)

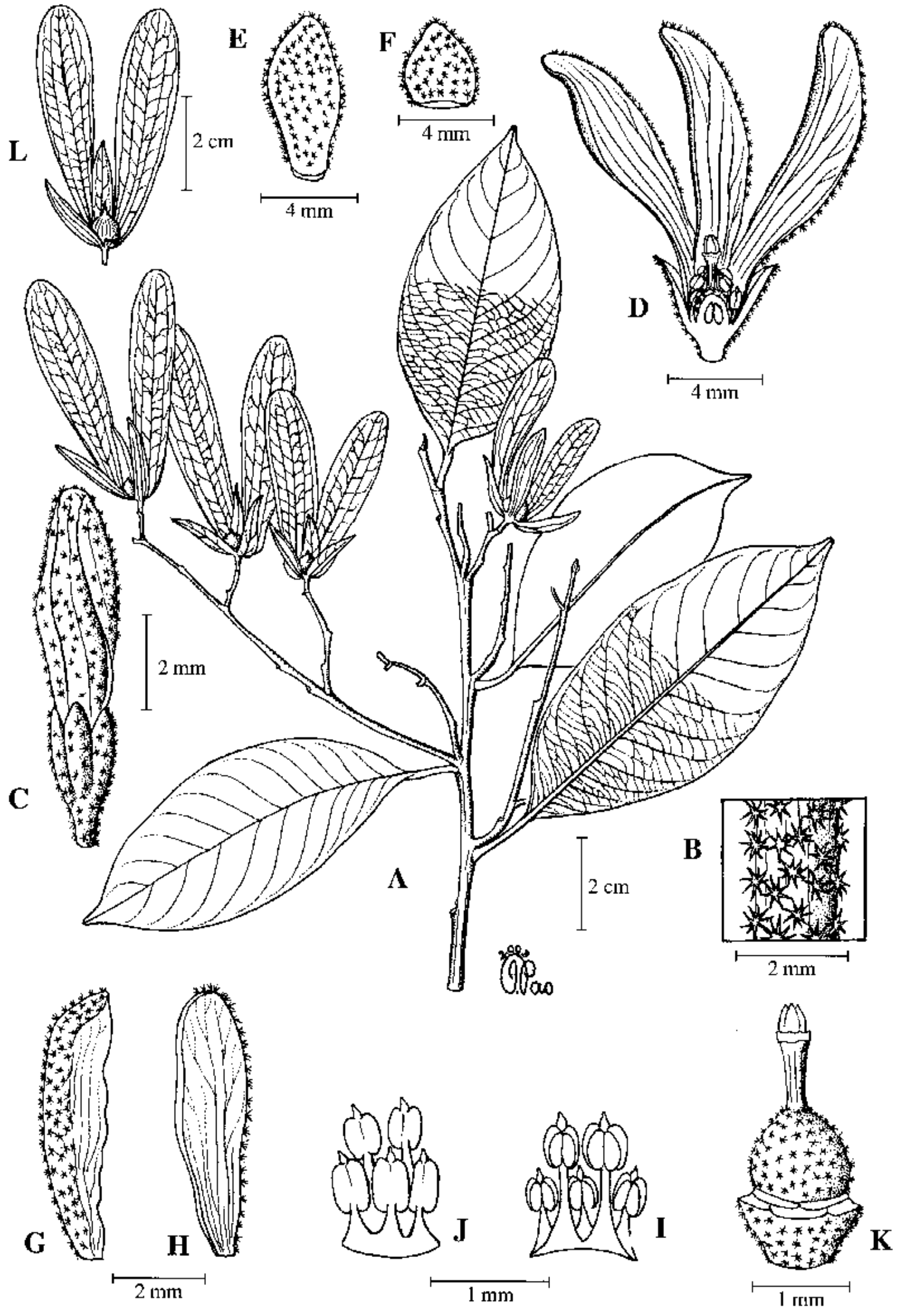

Fig. 35. *Vatica mangachapoi* subsp. *mangachapoi*. A, fruiting leafy twig; B, detail of indumentum of midrib on the lower leaf surface; C, flower bud; D, longitudinal section of open flower; E, abaxial view of outer sepal; F, abaxial view of inner sepal; G, abaxial side of petal; H, adaxial side of petal; I, adaxial view of stamens; J, abaxial view of stamens; K, gynoecium; L, fruit with exposed nut. (A–B and L from *FMS 41100*, C–K from *SAN 15459*.)

Simunjan districts (e.g., *S 23227*, *S 23244* and *S 42993*). Also occurring in Brunei (e.g., *BRUN 676* and *FMS 30517*) and Kalimantan.

Ecology. Rare and local, in mixed dipterocarp forest on sandy clay soil, apparently usually near water, sometimes, close to limestone. Likely critically endangered with extinction.

16. **Vatica maingayi** Dyer

(C. Maingay, 1836–1869, Superintendent of Malacca jail and naturalist)

Fl. Brit. Ind. 1 (1874) 302; Brandis *op. cit.* 131; Slooten *op. cit.* (1927) 85, *p.p.*; Symington *op. cit.* (1941) 151, *op. cit.* (1943) 223; Meijer & Wood *op. cit.* 309; Burgess *op. cit.* 227; Ashton *op. cit.* (1968) 33, *op. cit.* (1982) 369; Anderson *op. cit.* (1980) 132; PROSEA *op. cit.* 466. **Type:** *Maingay 209*, Peninsular Malaysia, Malacca (holotype K). **Synonyms:** *Synaptea maingayi* (Dyer) Ridl., FMP 1 (1922) 240, *p.p.*; *Vatica macroptera* Slooten *ex* Thorenaar, Med. Proefst. Boschw. 16 (1926) 120, Slooten *op. cit.* (1927) 83, *nomen in syn. sub V. lowii*; *V. aperta* Slooten *op. cit.* (1942) 250.

Medium-sized to large canopy tree, to 45 m tall, to 70 cm diameter. **Bark** eventually flaky. *Exposed young fleshy parts*, *leaf blade excepted*, *and ovary shortly rufous flocculent-tomentose*; *persistent on ovary and leaf bud*; *patchily caducous elsewhere.* **Twigs** *terete*, *c.* 2 mm diameter apically, smooth; *leaf buds prominent.* **Stipules** lorate, to 10 × 3 mm, leaving prominent horizontal scars. **Leaves** *thinly coriaceous*, *drying reddish brown*; *blade elliptic*, 5.5–12.5 × 1.2–5 cm, base cuneate, *margin not revolute*, *apex acuminate*, *with tapering acumen to 1 cm long*; *midrib prominent on both surfaces*; *lateral veins 9–11 pairs*, *with few short intermediates*, *slender but sharply prominent below*, arched; intercostal venation slender, reticulate; *petiole 1–2.5 cm long*, *slender*, ribbed, prominently geniculate, *drying black or not*. **Inflorescences** axillary; rachis ribbed, irregularly singly branched, to 4 cm long. **Flowers:** buds spindle-shaped, to 10 mm long; calyx rufous flocculent tomentose; corolla bright red; otherwise typical. **Fruits:** pedicels to 3 mm long; *calyx lobes unequal*, *free*, *chartaceous*, *2 longer lobes lorate to narrowly ovate*, *obtuse*, *somewhat revolute at base*, *not becoming reflexed*, *to 8 × 2.5 cm*, *to c. 7 mm wide at base*, 3 shorter ones narrowly ovate, acute, to 2.5 × 1 cm, to 3 mm wide at base. **Nuts** globose, to 0.7 cm diameter, shortly mucronate.

Vernacular names. Sabah—*resak daun merah* (preferred name). Sarawak—*resak lidi* (preferred name).

Distribution. Peninsular Malaysia, Sumatra (Palembang) and Borneo. In Sabah recorded from Sipitang and Tambunan districts (e.g., *SAN 15105* and *SAN 17036*) and in Sarawak from Bau, Belaga and Kuching districts (e.g., *S 9425*, *S 15785* and *S 24826*).

Ecology. In lowland mixed dipterocarp forest on yellow sandy clay soils. Rare and endangered.

17. **Vatica mangachapoi** Blanco Fig. 35.

(a Philippine vernacular name)

Fl. Filip. ed. 1 (1837) 401; Slooten *op. cit.* (1927) 94; Merrill, PEB (1929) 205; Masamune *op. cit.* 499; Browne *op. cit.* 101; Anderson, Gard. Bull. Sing. 20 (1963) 159, *op. cit.* (1980) 132; Ashton *op. cit.* (1963) 253, *op. cit.* (1964) 71, *op. cit.* (1968) 33, *op. cit.* (1978) 22, *op. cit.* (1982) 364; Meijer & Wood *op. cit.* 310; Burgess *op. cit.* 227; PROSEA *op. cit.* 468; Coode *et al.* (eds.) *op. cit.* 85. **Neotype** (designated here)**:** *Merrill Sp. Blancoan. 866* (= *US 904562*), the Philippines, Luzon, Bataan Province (K, US). **Synonyms:** *Mocanera mangachapoi* Blanco *op. cit.* (1837) 450; *Vatica apteranthera* Blanco, Fl. Filip. ed. 2 (1845) 156; *Dipterocarpus mangachapoi* (Blanco) Blanco *op. cit.* (1845) 313; *Shorea mangachapoi* (Blanco) Blume *op. cit.* 34; *Anisoptera mangachapoi* (Blanco) A.DC., Prodr. 16, 2 (1868) 616; *V. bureavi* F.Heim *op. cit.* (1891) 955; *Sunaptea bureavi* (F.Heim) F.Heim *op. cit.* (1892) 114; *V. reticulata auct. non* (Thwaites) A.DC.: King, J. As. Soc. Beng. 62, 2 (1893) 166; *Cotylelobium philippinense* F.Heim *ex* Brandis *op. cit.* 134; *V. obtusifolia* Elmer, Leafl. Philip. Bot. 4 (1912) 1471; *Synaptea reticulata* Ridl., *op. cit.* (1922) 243; *V. patula* Symington *op. cit.* (1941) 148.

Canopy tree, to 30 m tall, to 70 cm diameter; bole frequently crooked. *Exposed fleshy parts*, *leaf excepted*, *shortly densely cream-yellow puberulent*; *caducous except on inflorescence*. **Twigs** to 1.5 mm diameter apically, *terete*. **Stipules** narrowly oblong, to 5 × 2 mm, subacute. **Leaves** *thinly to thickly coriaceous*, somewhat shiny, *drying yellowish brown or pale greyish green*; *blade elliptic*, *6–11 × 2.7–5 cm*, *base cuneate*, *margin not revolute*, *apex obtuse or subacute*, *or acute with tapering acumen to 0.7 cm long*; *midrib terete below*, *raised above*; *lateral veins 7–9 pairs*, without intermediates, *slightly raised on both surfaces*, slightly arched; *intercostal venation densely reticulate*; *petiole 0.5–1 cm long*, *drying black or not.* **Inflorescences** terminal or axillary; rachis terete, singly or doubly branched, to 14 cm long. **Flowers:** buds to 12 mm long; calyx shortly densely cream-buff pubescent; otherwise typical. **Fruits:** pedicels to 4 mm long, slender; *calyx lobes unequal*, *free*, *chartaceous*, *2 longer lobes spatulate*, *obtuse*, *to 5.5 × 1.5 cm*, *to 3 mm wide at base*, *not becoming reflexed*, 3 shorter ones lanceolate, acute, to 1 × 0.4 cm. **Nuts** *subglobose*, to 0.4 × 0.6 cm, *shortly mucronate*.

Vernacular names. Sabah—*resak bajau* (preferred name). Sarawak—*resak julong* (Malay), *resak paya* (preferred name).

Distribution. Peninsular Thailand, Peninsular Malaysia, Borneo, and the Philippines.

Notes. Two subspecies, *viz.* subsp. *mangachapoi* and subsp. *obtusifolia*, are recognised in Sabah and Sarawak.

Key to subspecies

Leaves thinly coriaceous, apex with tapering acumen to 0.7 cm long. Inflorescence to 14 cm long. In forest on non-ultrabasic soils…...

> subsp. **mangachapoi**
>
> In Sabah known from Beaufort, Kinabatangan, Lahad Datu, Sandakan, Semporna, and Tawau districts (e.g., *SAN 15463*, *SAN 15504*, *SAN 29380*, *SAN 38937*, and *SAN 90785*) and in Sarawak from Kuching, Marudi, Mukah, Sibu, Simunjan, and Sri Aman districts (e.g., *S 3159*, *S 9429*, *S 12878*, and *S 77024*). Also occurring in Brunei (e.g., *KEP 80149*, *S 5813* and *Wong WKM 975*). Locally common, near the coast on dry ridges in *kerangas* forest on deep podsols on raised beaches and, particularly in Sarawak, in mixed peat swamp forest. Occurring in Bako NP; elsewhere vulnerable.

Leaves thickly coriaceous, apex obtuse or subacute. Inflorescence to 6 cm long. In forest on ultrabasic soils……………………………………………………………………………

> subsp. **obtusifolia** (Elmer) P.S.Ashton
>
> Gard. Bull. Sing. 31 (1978) 23, *op. cit.* (1982) 365. Basionym: *Vatica obtusifolia* Elmer *op. cit.* (1912) 1471. Lectotype (Ashton, 1978): *Elmer 12963*, the Philippines, Palawan, Puerto Princesa, Mt. Pulgar (hololectotype K; isolectotype NY).

Palawan and E Sabah, Bt. Masasan, Lahad Datu district (e.g., *SAN 25435*). On rocky hills, not far from the coast. Rare and endangered.

18. **Vatica maritima** Slooten

(Latin, *maritimus* = relating to the sea; the habitat)

Bull. Jard. Bot. Buitenz. 3, 17 (1942) 245; Ashton *op. cit.* (1964) 72, *op. cit.* (1968) 33, *op. cit.* (1982) 359; Meijer & Wood *op. cit.* 310; Burgess *op. cit.* 227; Anderson *op. cit.* (1980) 133; Coode *et al.* (eds.) *op. cit.* 85. **Type:** *Orolfo SAN 1828*, Borneo, Sabah, Kudat, Lokapas (holotype BO).

Medium-sized canopy tree, to 25 m tall, to 35 cm diameter. *Exposed fleshy parts*, *leaf blade excepted*, *and ovary densely more or less persistently cream puberulent.* **Twigs** *ribbed or somewhat compressed*, *to 8 mm diameter apically.* **Stipules** not seen. **Leaves** coriaceaous, drying dull yellowish brown; *blade broadly or narrowly ovate*, 8–16 × 3–8 cm, base broadly cuneate to subcordate, apex with broad acumen to 1 cm long; *lateral veins 7–10 pairs*, with short slender intermediates, *raised on both surfaces though more so below as also midrib and intercostal venation*; *petiole* 2–2.7 cm long, *to 3 mm diameter*, *slender*, hardly geniculate, *not drying black.* **Inflorescences** axillary or rarely terminal; rachis singly branched, lax, angled, to 11 cm long. **Flowers:** buds to 14 mm long; calyx densely pale brown tomentose; otherwise typical. **Fruits:** pedicels to 4 mm long; *calyx lobes unequal*, *chartaceous*, *united into a to 5 mm diameter shallow cup at base*, *2 longer lobes lorate-spatulate*, *obtuse*, *to 11 × 1.8 cm*, *tapering to 4 mm wide at base*, 3 shorter ones lanceolate, acute, to 1.8 × 0.6 cm. **Nuts** globose, to 0.6 cm diameter.

Vernacular name. Sabah and Sarawak—*resak laut* (preferred name).

Distribution. Borneo and the Philippines (Palawan Is.). In Sabah known from Kudat, Kota Kinabalu, Lahad Datu, and Sandakan districts (e.g., *SAN 5495*, *SAN 28441*, *SAN 35663*, *SAN 36136*, and *SAN A 3183*). Also occurring in Brunei (e.g., *FMS 37066*).

Ecology. Rare, in forest on rocky or yellow sandy soils on headlands near the sea. Critically endangered.

19. **Vatica micrantha** Slooten

(Greek, *micros* = small, *anthos* = flower; the supposedly small flowers)

Bull. Jard. Bot. Buitenz. 3, 17 (1942) 246; Ashton *op. cit.* (1964) 73, *op. cit.* (1968) 33, *op. cit.* (1982) 366; Meijer & Wood *op. cit.* 312; Burgess *op. cit.* 227; Anderson *op. cit.* (1980) 132; PROSEA *op. cit.* 469; Coode *et al.* (eds.) *op. cit.* 85. **Type:** *bb. 29706*, Borneo, C Kalimantan, Pepas, Muara Teweh (holotype BO; isotype L).

Canopy tree, to 35 m tall, to 60 cm diameter. *Exposed fleshy parts*, *including venation below but not blade*, *and ovary more or less densely persistently pale brown scabrid-pubescent*; *glabrescent on fruit calyx.* **Twigs** *c.* 2 mm diameter apically, *terete*, smooth or slightly striated. **Stipules** hastate, acute, to 7 × 3 mm. **Leaves** *thinly coriaceous*, drying greyish green; *blade* often bullate between lateral veins, *elliptic-oblong to lanceolate*, 4.5–16 × 1.5–6 cm, *base obtuse*, *margin not revolute*, *apex acuminate with slender acumen to 1.5 cm long*; *lateral veins 8–11 pairs*, with short slender intermediates, slender, *arching and anastomosing to form intramarginal vein*, *prominent below*, *flat above as also the* *intercostal venation and midrib*; *petiole 0.5–1 cm long*, *to 3 mm diameter*, *not drying black*. **Inflorescences** terminal or *axillary*, *not fascicled*; rachis singly branched, terete, to 7.5 cm long. **Flowers:** buds to 13 mm long; calyx shortly pubescent; corolla cream, suffused with violet towards the base outside; otherwise typical. **Fruits:** pedicels to 2.5 mm long; *calyx lobes unequal*, *free*, *chartaceous*, *2 longer lobes oblong-spatulate*, *subacute*, *to 5.8 × 1.5 cm*, *tapering to 3 mm wide*, *revolute base*, 3 shorter ones ovate, caudate-acuminate, to 2.5 × 0.6 cm, similar at base. **Nuts** ellipsoid, obtuse, to 1.4 × 0.8 cm; style remnant often absent.

Vernacular names. Sabah—*resak bulu* (preferred name). Sarawak—*resak hijau* (Malay).

Distribution. Endemic in Borneo; widespread. In Sabah recorded from Beaufort, Keningau, Kota Kinabalu, Kudat, Labuk Sugut, Lahad Datu, Sandakan, Semporna, Sipitang, Tawau, and Tenom districts (e.g., *SAN 15486*, *SAN 20652*, *SAN 30889*, *SAN 90854*, and *SAN 131865*) and in Sarawak from Bau, Belaga, Bintulu, Kapit, Kuching, Lawas, Limbang, Lundu, Marudi, Miri, Sri Aman, and Tatau districts (e.g., *S 1754*, *S 15134*, *S 25016*, *S 32204*, and *S 60127*). Also occurring in Brunei (e.g., *BRUN 613* and *Dransfield JD 6897*) and Kalimantan (e.g., *bb. 29706* and *Jarvie & Ruskandi 5894*).

Ecology. The commonest *Vatica* in Sabah and Sarawak. Common in mixed dipterocarp forest, on a wide range of sandy and clay soils including on basic volcanics and on the base of limestone hills. Common in Lambir NP; not vulnerable.

20. **Vatica nitens** King Plate 5E.

(Latin, *nitens* = shining; the leaf surface)

J. As. Soc. Beng. 2 (1893) 104; Slooten *op. cit.* (1927) 78; Ashton *op. cit.* (1964) 223, *op. cit.* (1968) 34, *op. cit.* (1982) 367; Anderson *op. cit.* (1980) 132; PROSEA *op. cit.* 469; Coode *et al.* (eds.) *op. cit.* 85. **Type:** *Curtis 1404*, Peninsular Malaysia, Penang, Government Hill (holotype CAL). **Synonym:** *Synaptea nitens* (King) Ridl., *op. cit.* (1922) 241.

Large canopy tree, to 40 m tall, to 70 cm diameter. *Exposed young fleshy parts densely powdery rufous pubescent*, *persisting only on leaf bud*, *stipule*, *inflorescence and ovary.* **Stipules** narrowly oblong, subacute, to 20 × 3.5 mm, caducous. **Twigs** *terete*. **Leaves** *coriaceous*, glistening, drying rich pinkish brown; *blade narrowly oblong*, 35–55 × 10–17 cm, base obtuse or cuneate, *margin not revolute*, *apex acuminate with tapering acumen to 1 cm long*; *lateral veins 12–22 pairs with many short intermediates*, arched, *raised below*, *flat or slightly elevated above as also the midrib and intercostal venation*; *petiole 1–2 cm long*, *to 2.5 mm diameter*, *not drying black*, geniculate. **Inflorescences** terminal or occasionally axillary; rachis singly, rarely doubly, branched, to 11 cm long. **Flowers:** buds spindle-shaped, to 7 × 3 mm; calyx densely pubescent on both surfaces; otherwise typical. **Fruits:** pedicels to 5 mm long, fruit base impressed; *calyx lobes unequal*, *free*, *pubescent at first*, *2 longer lobes oblong*, *obtuse*, *slightly recurved*, *to 13 × 2 cm*, *tapering to 7 mm wide at base*, 3 shorter ones hastate, acute, to 3.8 × 0.9 cm, to 7 mm wide at base. **Nuts** globose, to 3 cm diameter.

Vernacular name. Sarawak—*resak daun panjang* (Malay).

Distribution. Sumatra (Riau), Peninsular Malaysia and Borneo. In Sabah known from Beaufort, Kota Kinabalu and Sipitang districts (e.g., *SAN 16831*, *SAN 23859*, *SAN 36767*, and *SAN A 4512*) and in Sarawak from Bau, Bintulu, Kapit, Kuching, Lundu, Miri, and Tatau districts (e.g., *S 10032*, *S 20281*, *S 25026*, *S 29201*, and *S 37855*). Also occurring in Brunei (e.g., *BRUN 3276* and *FMS 30528*) and E and W Kalimantan (e.g., *Arifin Berau 570* and *bb. 35295*).

Ecology. Locally frequent in mixed dipterocarp forest on well-drained sandy and sandy clay soils, on low ridges, at altitudes to 600 m. Common in Lambir NP and recorded from G. Gading NP; elsewhere vulnerable.

21. **Vatica oblongifolia** Hook.*f.*

(Latin, *oblongus* = rather long, *folius* = leaf; the leaf shape)

Trans. Linn. Soc. 23 (1862) 160; Merrill *op. cit.* (1921) 409; Slooten *op. cit.* (1927) 109, *op. cit.* (1941) 135; Masamune *op. cit.* 199; Browne *op. cit.* 101; Ashton *op. cit.* (1964) 75, *op. cit.* (1967) 264, *op. cit.* (1968) 34, *op. cit.* (1982) 355; Meijer & Wood *op. cit.* 314; Burgess *op. cit.* 227; Anderson *op. cit.* (1980) 132; PROSEA *op. cit.* 469; Kessler & Sidiyasa, TBSA-EK (1994) 113; Coode *et al.* (eds.) *op. cit.* 86. **Type:** *Lowe s.n.*, Borneo, Sabah (holotype K).

Canopy tree, to 35 m tall, to 50 cm diameter. *Exposed fleshy parts including young fruit densely evenly persistently vinous-sericeous.* **Twigs** *at first compressed*, *c.* 2–4 × 1–2 mm apically, smooth. **Stipules** oblong, obtuse, to 4.5 × 1.2 cm, fugaceous. **Leaves** thinly to thickly coriaceous, *bluish green with purplish venation below when fresh*, *drying dull greyish brown*; blade flate to somewhat concave, narrowly to broadly elliptic, or narrowly to broadly oblong, or narrowly obovate to obovate-oblong, 6.5–31 × 2.5–10.5 cm, base cuneate, obtuse, to more or less cordate, apex acute, acuminate, to subcaudate, acumen 1–1.5 cm long; midrib prominent and terete below, sunken above; *lateral veins 10–27 pairs*, *with short more or less prominent intermediates*, prominent below, arched within margin; petiole 1.4–5 cm long, stout, geniculate, drying not black. **Inflorescences** *compressed*, singly or doubly branched, terminal or in axillary cluster to 3, to 8 cm long. **Flowers:** buds to 15 mm long; petals cream, purplish towards the base; otherwise typical. **Fruits:** pedicels to 8 mm long; *calyx lobes equal*, *free*, *thickly coriaceous*, deltoid, oblong or obovate, *acute*, *obtuse or retuse*, *becoming reflexed*, *subrotate or revolute*, *to 0.3–1.5 × 0.2–1.2 cm*. **Nuts** *globose*, *to 2 cm diameter*, *smooth*, *faintly 3-furrowed.*

Vernacular names. Sabah—*resak daun panjang* (preferred name). Sarawak—*resak membangan* (preferred name).

Distribution. Endemic in Borneo.

Ecology. In mixed dipterocarp forest on well-drained sandy, sandy clay and shallow clay soils, at altitudes to 1000 m.

Notes. In Sabah and Sarawak, five subspecies are recognised, with distinct albeit overlapping ecological ranges.

Key to subspecies

1. Petiole at most 1.4 cm long; leaf broadly elliptic..……….………………….…………
   subsp. **elliptifolia** P.S.Ashton
   (Latin, *ellipticus* = broadest at the middle with curved sides, *folius* = leaf; the leaf shape)
   Gard. Bull. Sing. 22 (1967) 265, *op. cit.* (1968) 34, *op. cit.* (1982) 356; Coode *et al*. (eds.) *op. cit.* 86. Type: *Ashton BRUN 925*, Borneo, Brunei, Bt. Kukub, Andulau hills (holotype K; isotypes KEP, L).
   Twigs *c.* 3 × 2 mm apically. *Leaf blade broadly elliptic*, *12–20 × 3.5–7 cm*, base broadly cuneate, apex acute with slender acumen to 1 cm long; *petiole to 1.4 cm long*. Fruits: calyx lobes oblong, to 0.8 × 0.4 cm, obtuse, revolute.
   In Sarawak recorded from Miri district (e.g., *S 24432*). Also occurring in Brunei (e.g., the type). Rare, in mixed dipterocarp forest on deep sandy soils on coastal hills, and on the Arip rhyolite, at altitude below 300 m. Critically endangered.
   Petiole at least 1.5 cm long; leaf various, not generally broadly elliptic……….….…2

2. Fruit calyx lobes at least 1.3 × 0.8 cm; leaf lateral veins 16–27 pairs…………..……....3
   Fruit calyx lobes at most 0.4 × 0.3 cm; leaf lateral veins 11–18 pairs……...…………....4

3. Leaf blade broadly oblong, base obtuse to more or less cordate……...…………………….
   subsp. **crassilobata** P.S.Ashton
   (Latin, *crassus* = thick, *lobatus* = lobed; the fruit calyx lobes)
   Gard. Bull. Sing. 22 (1967) 265, *op. cit.* (1968) 34, *op. cit.* (1982) 356; Coode *et al*. (eds.) *op. cit.* 86. Type: *Ashton BRUN 614*, Borneo, Brunei, Andulau FR (holotype K; isotypes KEP, L).
   Twigs *c.* 4 × 2 mm apically, stout. *Leaf blade thickly coriaceous*, *often somewhat concave*, *broadly oblong*, 11.5–21 × 4.5–10.5 cm, *base obtuse more or less cordate*, apex acute with short, broad acumen; *lateral veins stoutly prominent below*, *16–23 pairs*; *petiole 1.8–2.8 cm long*, *stout. Fruit calyx lobes obovate*, *to 1.5 × 1.2 cm*, obtuse to retuse, subrotate.
   Known in Sarawak from Bintulu, Kapit, Miri, and Simunjan districts (e.g., *S 23225*, *S 27127*, *S 39618*, *S 59590*, and *S 63662*). Also occurring in Brunei (e.g., *BRUN 615* and *BRUN 5157*) and W Kalimantan. Locally common in mixed dipterocarp forest, on deep yellow sands on hills behind the swamps or on the coast, at altitudes below 400 m. Common in Lambir NP and locally so in Mulu NP; elsewhere endangered by forest conversion.
   Leaf blade narrowly obovate, base more or less cuneate...…..……………………….…
   subsp. **multinervosa** P.S.Ashton
   (Latin, *multus* = many, *nervosus* = nerved; the many-veined leaf)
   Gard. Bull, Sing. 22 (1967) 265, *op. cit.* (1968) 34, *op. cit.* (1982) 356; Coode *et al*. (eds.) *op. cit.* 86. Type: *Meijer SAN 19713*, Borneo, Sabah, Sandakan, Sepilok FR (holotype K; isotypes KEP, L).
   Twigs *c.* 4 × 2 cm apically, stout. *Leaf blade narrowly obovate*, 14–31 × 4–8.5 cm, *base narrowly obtuse or cuneate*, *apex*, *acuminate with slender acumen to 1.5 cm long*; *lateral veins 18–27 pairs*, with prominent short intermediates, very prominent below; *intercostal venation distinctly elevated below*; *petiole 1.5–2.5 cm long. Fruit calyx lobes* oblong, *to 1.3 × 0.8 cm*, obtuse, reflexed.
   Recorded in E Sabah from Lahad Datu, Sandakan and Tawau districts (e.g., *SAN 22509*, *SAN 30052*, *SAN 34083*, *SAN 88089*, and *SAN 93092*) and in Sarawak from Belaga, Bintulu, Kapit, Limbang, Lundu, and Tatau districts (e.g., *S 12623*, *S 22240*, *S 41769*, *S 43465*, and *S 66118*). Also occurring in Brunei (e.g., *BRUN*

5786) and NE Kalimantan (e.g., *bb. 18163* and *Kostermans 8603*). Locally common in mixed dipterocarp forest on deep fertile clay-rich soils, especially on basic igneous rocks, at altitude to 800 m; also on shale, and on rhyolite. Occurring in Lambir and Mulu NPs; not vulnerable.

4. Leaf blade narrowly elliptic, base cuneate; petiole 1.5–2.5 cm long……………………..
subsp. **selakoensis** P.S.Ashton
(of Selako, W Sarawak)

Gard. Bull. Sing. 22 (1967) 265, *op. cit.* (1968) 34, *op. cit.* (1982) 356; Coode *et al*. (eds.) *op. cit.* 86. Type: *Ilias S 13340*, Borneo, Sarawak, G. Gading FR (holotype K; isotypes KEP, L).

Twigs *c.* 2 × 1 mm apically, slender. *Leaf blade* thinly coriaceous, *narrowly elliptic*, 6.5–22 × 2.5–6.5 cm, *base cuneate*, apex subcaudate, acumen to 1.5 cm long; *lateral veins 11–18 pairs*, with short indistinct intermediates, slender, hardly raised below; *petiole 1.5–2.5 cm long. Fruit calyx lobes oblong*, *to 0.4 × 0.3 cm*, obtuse.

Confined to mountains in Lundu district, W Sarawak (e.g., *S 13171* and *S 18466*). Common in upper dipterocarp forest on shallowly humic soils, at 600–1000 m altitude on granodiorite, mostly along ridges. Common in G. Gading NP, vulnerable to clearing on the summits.

Leaf blade obovate to oblong, base obtuse; petiole 2.5–5 cm long………………………
subsp. **oblongifolius**

Twigs *c.* 4 × 2 mm apically, compressed, smooth. *Leaf blade* coriaceous, *obovate to oblong*, 10–31 × 4.5–10 cm, *base obtuse*, apex abruptly acute to broadly acuminate; *lateral veins 10–18 pairs*, with short more or less prominent intermediates; *petiole 2.5–5 cm long*, stout, geniculate. *Fruit calyx lobes* deltoid, *to 0.3 × 0.2 cm.*

Widespread throughout Borneo; in Sabah known from Beaufort, Kinabatangan, Kota Kinabalu, Kudat, Labuk Sugut, Ranau, Sandakan, and Sipitang districts (e.g., *SAN 16424*, *SAN 16845*, *SAN 20702*, *SAN 77868*, and *SAN 97513*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lawas, Lundu, Marudi, Miri, and Tatau districts (e.g., *S 13305*, *S 21550*, *S 32056*, *S 45513*, and *S 66998*). Also occurring in Brunei (e.g., *BRUN 2623* and *Wong WKM 84*) and Kalimantan (e.g., *Kostermans 7299* and *Kostermans 10624*). Frequent and locally common in mixed dipterocarp forest on sandy, sandy clay and shallow clay soils, at altitudes to 1000 m. Well represented in the parks system; not vulnerable.

22. **Vatica odorata** (Griff.) Symington Plate 5F.

(Latin, *odoratus* = scented; the flowers)

J. Malay. Br. Roy. As. Soc. 19 (1941) 156, *op. cit.* (1943) 224; Ashton *op. cit.* (1964) 75, *op. cit.* (1967) 263, *op. cit.* (1978) 23, *op. cit.* (1982) 360; PROSEA *op. cit.* 470; Kessler & Sidiyasa *op. cit.* 113. **Basionym:** *Sunaptea odorata* Griff., *op. cit.* 516. **Type:** *Griffith s.n.*, Myanmar, Mergui, Tennaserim (holotype CAL). **Synonyms:** *Hopea grandiflora* Wall. *ex* A.DC., *op. cit.* 634; *Synaptea grandiflora* (Wall. *ex* A.DC.) Kurz *op. cit.* (1870) 65; *Anisoptera odorata* (Griff.) Kurz, Flora 30 (1872) 191; *Vatica grandiflora* (Wall. *ex* A.DC) Dyer *op. cit.* (1874) 301; *V. faginea* Dyer *op. cit.* (1874) 301; *V. astrotricha* Hance, J. Bot. 14 (1876) 241; *Sunaptea astrotricha* (Hance) Pierre, For. Fl. Coch. (1891) *t.* 240; *Sunaptea dyeri* Pierre, *l.c.* (1891) *t.* 241; *Sunaptea faginea* (Dyer) Pierre *op. cit.* (1891) 242; *V. curtisii* King *op. cit.* 105.

Canopy tree, to 40 m tall, to 60 cm diameter. *Exposed fleshy parts*, *leaf blade and venation excepted*, *more or less densely pale yellowish to rust-brown pubescent*; *indumentum caducous on fruit calyx*, *more or less persistent elsewhere*. **Twigs** *c.* 1.5 mm diameter apically, *terete*, rugose, frequently finely flaky. **Stipules** oblong, obtuse, *c.* 8 × 2 mm, caducous. **Leaves** thinly coriaceous, drying pale yellowish brown or greyish brown; *blade narrowly elliptic to ovate*, *8–16 × 2.7–5.5 cm*, base obtuse or cuneate, apex acuminate, acumen to 0.8 cm long; *lateral veins 11–15 pairs*, *raised below*, *flat above as also the midrib*, *not forming intramarginal vein*; *intercostal venation not prominent below*; *petiole* 0.8–2 cm long, *less than 3 mm diameter*, geniculate or not, *not drying black*. **Inflorescences** terminal or axillary; rachis singly branched, to 7 cm long. **Flowers:** buds to 8 mm long; calyx densely shortly pale greyish brown tomentose; otherwise typical. **Fruits:** pedicels *c.* 3 mm long, slender; *calyx lobes unequal*, *chartaceous*, *united at base in a to 8 mm diameter*, *3 mm deep shallow cup*, *2 longer lobes spatulate*, *obtuse*, *to 5.5 × 1.5 cm*, *tapering to 2.5 mm broad at base*, *not becoming reflexed*, 3 shorter ones hastate, acute, to 1.4 × 0.4 cm. **Nuts** globose, to 0.7 cm diameter, with 2 mm filiform style remnant, basal half adnate to the calyx cup.

Vernacular names. Sabah—*resak biabas* (preferred name). Sarawak—*resak ranting kesat* (Malay).

Distribution. S China, Myanmar (Tennasserim), Thailand, Indo-China, Peninsular Malaysia, Borneo and the Philippines.

Ecology. In aseasonal mixed dipterocarp forest and in seasonal mixed dipterocarp forest, at altitudes to 1900 m.

Notes. Two subspecies, *viz.* subsp. *mindanensis* and subsp. *odorata*, are recognised in Sabah and Sarawak.

Key to subspecies

Leaf blade drying pale yellowish brown; petiole not geniculate, 0.8–1.2 cm long. In aseasonal and seasonal mixed dipterocarp forest at altitudes to 700 m……………………… subsp. **odorata**

In Borneo, known from Sipitang and Tawau districts in Sabah (e.g., *SAN 16714*, *SAN 17159* and *SAN 40586*) and E Kalimantan (e.g., *Ambri & Arifin 1016*). In mixed dipterocarp forest at altitudes to 700 m. In Sabah rare and endangered.

Leaf blade drying greyish brown; petiole geniculate, 1.5–2 cm long. In aseasonal mixed dipterocarp and upper dipterocarp forest at altitudes to 1900 m……………………………… subsp. **mindanensis** (Foxw.) P.S.Ashton

(of Mindanao, the Philippines)

Gard. Bull. Sing. 22 (1967) 263, *op. cit.* (1978) 24, *op. cit.* (1982) 361; PROSEA *op. cit.* 470; Coode *et al.* (eds.) *op. cit.* 86. Basionym: *Vatica mindanensis* Foxw. *in* Elmer Leafl. Philip. Bot. 6 (1913) 1957, Slooten *op. cit.* (1927) 71, Meijer & Wood *op. cit.* 313, Burgess *op. cit.* 227. Lectotype (designated here): *Elmer 13398*, the Philippines, Mindanao, Mt. Urdaneta (hololectotype K). Synonyms: *V. sorsogonensis* Foxw., Philip. J. Sci. 13 (1918) Bot. 196; *V. aerea* Slooten *op. cit.* (1941) 133.

In Borneo and the Philippines. In Sabah recorded from Lahad Datu, Ranau, Sipitang, Tambunan, and Tawau districts (e.g., *SAN 16354*, *SAN 16667*, *SAN 17036*, *SAN 38436*, and *SAN 95838*) and in Sarawak from Bau, Belaga, Kapit, Kuching, Lawas, Limbang, Lubok Antu, Lundu, Samarahan, Sri Aman, and Tatau districts (e.g., *S 10061*, *S 19014*,

> *S 24704*, *S 36676*, and *S 68183*). Also occurring in Brunei (e.g., *BRUN 2540* and *BRUN 5237*) and W Kalimantan (e.g., *Suzuki K 9658* and *Suzuki K 9994*). In mixed and upper dipterocarp forest, at altitudes to 1900 m, on clays soils overlying shale, dacite, granodiorite, and basalt. Probably not vulnerable.

23. **Vatica parvifolia** P.S.Ashton

(Latin, *parvus* = small, *folius* = leaf)

Gard. Bull. Sing. 19 (1962) 316, *op. cit.* (1964) 76, *op. cit.* (1968) 35, *op. cit.* (1982) 365; Anderson *op. cit.* (1980) 133; Coode *et al.* (eds.) *op. cit.* 86. **Type:** *Ariffin S 371*, Borneo, Sarawak, Lundu district, Bt. Sebandar (holotype K; isotype KEP).

Canopy tree, to 35 m tall, to 35 cm diameter. *Exposed fleshy parts and ovary persistently densely rufous-brown powdery pubescent.* **Twigs** *terete*, to 1 mm diameter apically, slender, much-branched. **Stipules** linear, to 5 × 1 mm, caducous. **Leaves** *coriaceous*, *drying reddish brown*; *blade narrowly ovate to lanceolate*, 2.8–6 × 1–2.3 cm, *base obtuse*, *margin not revolute*, *apex caudate with acumen to 1 cm long*; *midrib slender*, *prominent below*, *flat above*; *lateral veins c. 8 pairs*, *hardly raised*, *indistinct*, *arched*; *petiole 0.6–0.9 cm long*, *not drying black.* **Inflorescences** terminal or axillary; rachis terete, singly branched, to 2 cm long. **Flowers:** buds to 6 mm long; calyx greyish brown pubescent; otherwise typical. **Fruits:** pedicels to 3 mm long, slender; *calyx lobes unequal*, *free*, *chartaceous*, *glabrescent except towards base*, *2 longer lobes oblong*, *narrowly obtuse*, *to 6 × 0.7 cm*, *revolute above the abruptly narrowly constricted base*, *not becoming reflexed*; 3 shorter ones broadly ovate, to 1 × 0.7 cm, acute, cordate, prominently revolute. **Nuts** *broadly ovoid*, *to 0.5 × 0.35 cm*, *obtuse.*

Vernacular name. Sarawak—*resak kerangas padi* (preferred name).

Distribution. Endemic in Borneo. In Sabah known from Sandakan district (e.g., *SAN 16370*) and in Sarawak from Kuching, Limbang and Lundu districts (e.g., *S 5318*, *S 6001*, *S 6833*, *S 7537*, and *S 12508*). Also occurring in Brunei (e.g., *BRUN 2007* and *FMS 34475*).

Ecology. Very local, in *kerangas* forest on shallow and giant podsols, at altitudes below 300 m. Critically endangered.

24. **Vatica patentinervia** P.S.Ashton

(Latin, *patens* = diverging from the axis at a wide angle, *nervia* = nerve; the lateral veins of the leaf)

Gard. Bull. Sing. 54 (2002) 214. **Type:** *Ilias S 15148*, Borneo, Sarawak, Bintulu district, Segan FR (holotype K; isotypes KEP, SAR).

Medium-sized canopy tree, to 35 m tall, to 35 cm diameter. *Young fleshy parts pale yellowish buff scabrid-puberulent*; *indumentum persistent on petiole*, *leaf venation below and midrib above.* **Twigs** *c.* 2 mm diameter apically, *terete*, more or less ribbed. **Stipules** not seen. **Leaves** *coriaceous*, drying dull pale yellowish brown; *blade elliptic to obovate*, 12–18 × 4.5–7 cm, base obtuse, *margin not revolute*, *apex obtuse to shortly acuminate*; venation including midrib somewhat elevated above, more or less prominently so below; *lateral veins 7–8 pairs*, *distinctly raised below*; *petiole to 2.5 cm long*, *to 3 mm diameter*, *drying pale buff brown*, rugose. **Inflorescences** *ramiflorous*, *in axillary clusters of 3*, *or terminal*; rachis singly branched, to 3 cm long. **Flowers** unknown. **Fruits:** *pedicels to 4 mm long*, *slender*; *calyx lobes unequal*, *free*, *chartaceous*, *2 longer lobes lorate-oblong*, *obtuse*, *to 12 × 2.2 cm*, *constricted and somewhat revolute at base*, 3 shorter ones hastate, to 4.5 × 1.5 cm, acuminate, revolute. **Nuts** ellipsoid, to 1.2 × 0.8 cm, mucronate, glabrous.

Distribution. Known only from the type locality in Sarawak, and Kuala Belalong, Temburong district in Brunei (e.g., *S 5744*).

Ecology. Apparently locally frequent in Temburong; in both localities in mixed dipterocarp forest on clay soils, at altitudes below 400 m. Conservation status uncertain.

25. **Vatica pedicellata** Brandis

(Latin, *pedicellatus* = with a prominent stalk; the flowers)

J. Linn. Soc. Bot. 31 (1895) 125; Merrill *op. cit.* (1921) 409; Slooten *op. cit.* (1927) 111; Masamune *op. cit.* 499; Browne *op. cit.* 101; Ashton *op. cit.* (1968) 35, *op. cit.* (1982) 356; Anderson *op. cit.* (1980) 133. **Type:** *Haviland 1041/869*, Borneo, Sarawak, Lundu district (holotype K; isotype KEP).

Small tree, to 15 m tall, to 15 cm diameter. *Exposed fleshy parts*, *leaf surface excepted*, *and ovary persistently densely vinous-sericeous.* **Twigs** *c.* 2 mm diameter apically, *terete* or slightly compressed only, hardly branched, smooth. **Stipules** lorate, subacute, to 7 × 2 mm, caducous. **Leaves** coriaceous, *bluish green with purplish venation below when fresh*, *drying mauve-brown*; *blade elliptic to lanceolate*, *9–23 × 3.5–7.5 cm*, *base obtuse* or rarely cuneate, margin narrowly revolute, apex with slender acumen to 2 cm long; midrib prominent below, elevated within a furrow above; *lateral veins 9–15 pairs*, with many short slender intermediates, slender, *hardly raised on either surface though more so below*, arched and anastomosing to form a faint looped intramarginal vein; *petiole 1–2.5 cm long*, *2–3 mm diameter*, *not or hardly geniculate*, *terete but rugulose and not turning black on drying.* **Inflorescences** axillary; rachis singly or doubly branched, compressed, ribbed, slender, to 8 cm long. **Flowers:** buds spindle-shaped, to 6 × 2 mm; calyx vinous puberulent; corolla cream with a purplish suffusion outside; otherwise typical. **Fruits** *vinous cinereous throughout*; pedicels to 8 mm long, slender; *calyx lobes free*, *subequal*, *oblong*, *to 0.6 × 0.4 cm*, obtuse, incrassate, revolute, reflexed. **Nuts** *subglobose*, *to 1.8 × 2.2 cm*, subacute, with obscure sutures.

Distribution. Endemic in Borneo; known only from Kuching, Lundu and Simunjan districts in Sarawak (e.g., *S 4672*, *S 7252*, *S 15233*, *S 39416*, and *S 68078*).

Ecology. Locally frequent in *kerangas* forest, usually on rocky slopes near the sea. Well represented in Bako NP; not vulnerable.

26. **Vatica perakensis** King

(of Perak, Peninsular Malaysia)

J. As. Soc. Beng. 62, 2 (1893) 103, *p.p. emend.* Symington *op. cit.* (1941) 152, *op. cit.* (1943) 226; Slooten *op. cit.* (1927) 86, *p.p.*; Ashton *op. cit.* (1978) 24, *op. cit.* (1982) 367. **Lectotype** (Symington, 1941)**:** *King's Collectors 7549*, Peninsular Malaysia, Perak, Larut (hololectotype CAL). **Synonyms:** *Synaptea perakensis* (King) Ridl., *op. cit.* (1922) 242, *p.p.*; *Vatica songa* Slooten *op. cit.* (1927) 93.

Small to medium-sized tree, to 30 m tall, to 30 cm diameter. *Exposed fleshy parts*, *leaf blade excepted*, *and ovary persistently greyish pink to pale yellowish brown cinereous*; *leaf venation below and nut glabrescent.* **Twigs** *c.* 1 mm diameter apically, slender, *terete*, much-branched. **Stipules** fugaceous, not seen. **Leaves** *thinly coriaceous*, *drying pale greyish brown*; *blade lanceolate to oblanceolate*, 6–14 × 1.8–3.8 cm, base cuneate, *margin not revolute*, *apex subcaudate*, *acumen to 2 cm long*; *lateral veins 11–13 pairs*, *slender but prominent below*, *evident above*, as also the midrib, ascending; intercostal venation densely subreticulate, evident on both surfaces; *petiole slender*, *1–2 cm long*, *not drying black.* **Inflorescence** slender; rachis singly branched, to 5 cm long. **Flowers** typical. **Fruits:** pedicels to 6 mm long, slender; *calyx lobes unequal*, *free*, *chartaceous*, *2 longer lobes spatulate*, *obtuse*, *to 6 × 1.8 cm*, *tapering to c. 5 mm wide at the subrevolute base*, 3 shorter ones lanceolate, acute, to 1.5 × 0.6 cm. **Nuts** ovoid, apiculate, to 1 cm diameter.

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo two tentative records from Lahad Datu and Tawau districts in SE Sabah (*i.e.*, *SAN 20119* and *SAN 41580*).

Ecology. In 'coastal hill dipterocarp forest' of Symington (*op. cit.* (1943) 15, fig. 2) on dry ridges, especially near the coast. Conservation status unknown but likely endangered.

27. **Vatica rassak** (Korth.) Blume

(after the Malay common name—*resak*)

Mus. Bot. Lugd.-Bat. 2 (1852) 31 (incl. var. *subcordata* Blume); Merrill *op. cit.* (1921) 409; Slooten *op. cit.* (1927) 73, 104, *op. cit.* (1942) 223; Masamune *op. cit.* 499; Ashton *op. cit.* (1978) 20, *op. cit.* (1982) 353; PROSEA *op. cit.* 471; Kessler & Sidiyasa *op. cit.* 114. **Basionym:** *Retinodendron rassak* Korth., *op. cit.* 56. **Type:** *Korthals s.n.* (= *RHL Sheet No. 900171121*), Borneo, Kalimantan, banks of Sg. Barito, Lower Dyak (holotype L). **Synonyms:** *Vateria rassak* (Korth.) Walp., Rep. 5 (1845) 126; *Vatica papuana* Dyer, J. Bot. 16 (1878) 100, Slooten *op. cit.* (1927) 73, *op. cit.* (1942) 233, Meijer & Wood *op. cit.* 314, Burgess *op. cit.* 227, Ashton *op. cit.* (1968) 35, Anderson *op. cit.* (1980) 132; *Vatica moluccana* Burck *op. cit.* 226; *R. moluccanum* (Burck) F.Heim *op. cit.* (1892) 104; *Vatica schumanniana* Gilg, Bot. Jahrb. 18 (1894) Beibl. 45; *Vatica celebensis* Brandis *op. cit.* 126; *Vatica subcordata* (Blume) Hallier *f.*, Med. Rijksherb. 36 (1918) 4, Slooten *op. cit.* (1942) 237; *Vatica celebica* Slooten *op. cit.* (1942) 237.

Large canopy tree, to 30 m tall, to 70 cm diameter. *Exposed fleshy parts*, *leaf surface excepted*, *and ovary persistently evenly pale buff-puberulent*; *fruit glabrescent.* **Twigs** *c.* 3 mm diameter apically, stout, crooked, ribbed, becoming rugose, flaky; stipule scars prominent. **Stipules** lorate, subacute, to 14 × 4 mm, subpersistent. **Leaves** thickly coriaceous, drying dull greyish brown; blade oblong to narrowly elliptic, 13–32 × 5–11 cm, base broadly cuneate to subcordate, apex with tapering acumen to 1.5 cm long; midrib prominent below, flat above; *lateral veins 16–20 pairs*, *prominent below*, *slightly elevated above*; *petiole 2–2.5 cm long*, *at least 3 mm diameter*, *stout*, not geniculate, *not drying black.* **Inflorescences** terminal or axillary; rachis ribbed, irregularly branched mostly from the base, appearing fascicled, to 14 cm long. **Flowers:** buds spindle-shaped, to 14 × 3 mm; calyx densely shortly pale buff pubescent; otherwise typical. **Fruits:** pedicels to 3 mm long, short, stout; *calyx lobes free*, *subequal*, deltoid, acute, incrassate, *reflexed*, *recurved*, *to 1.2 × 0.7 cm.* **Nuts** *oblong to ovoid*, to 5 × 3.5 cm, very variable, obtuse to tapering-apiculate, *frequently asymmetric*, *verrucose with thick corky pericarp*, prominently 3-furrowed.

Distribution. Borneo, Sulawesi, Maluku, New Guinea, and Sudest Is. In Sabah recorded from Beaufort, Kinabatangan, Lahad Datu, Papar, Sandakan, Semporna, and Sipitang districts (e.g., *SAN 25971*, *SAN 30718*, *SAN 57362*, *SAN 84454*, and *SAN 111491*) and in Sarawak from Belaga and Sibu districts (e.g., *S 9727* and *S 39310*). Also occurring in S Kalimantan (e.g., *Kessler and Ambriansyah B1440* and *Sidiyasa PBU 443*). The furthest east known dipterocarp.

Ecology. On and near banks of sluggish including brackish rivers in Sabah and Sarawak, on low hills in lowland mixed forest elsewhere. Vulnerable owing to its accessible habitat.

28. **Vatica rotata** P.S.Ashton

(Latin, *rotatus* = like a wheel; the spreading fruit calyx lobes)

Gard. Bull. Sing. 22 (1967) 270, *op. cit.* (1968) 36, *op. cit.* (1982) 357; Anderson *op. cit.* (1980) 133. **Type:** *Ashton S 19594*, Borneo, Sarawak, Mukah, Ulu Kenyana (holotype K; isotypes KEP, L).

Small tree, *c.* 10 cm diameter. *Exposed fleshy parts*, *including midrib below and fruit but excluding leaf blade*, *persistently densely vinous-sericeous*. **Twigs** *c.* 1 mm diameter apically, slender, much-branched, *terete*, smooth. **Stipules** not seen. **Leaves** coriaceous, *bluish green with purplish midrib below when fresh*, *drying dull greyish brown*; *blade broadly elliptic-ovate*, *5.5–10 × 3–5 cm*, *base obtuse*, apex with slender acumen to 0.8 cm long; midrib slender but prominent below, evident towards base above, otherwise obscurely sunken; *lateral veins 9–11 pairs*, without intermediates, *slender*, *arched*, *hardly raised*; intercostal venation densely reticulate, evident below; *petiole 0.8–1.2 cm long*, *slender*, *not drying black.* **Inflorescences** terminal or axillary; rachis slender, terete, singly branched, to 1.5 cm long. **Flowers** typical. **Fruits:** pedicels to 9 mm long, slender; *calyx lobes free*, *equal*, *suborbicular*, *incrassate*, *revolute*, *rotate*, *to 0.7 × 0.4 cm*. **Nuts** *subglobose*, *c. 0.4 cm diameter* (immature), obtuse, indistinctly 3-sutured.

Distribution. Endemic in Borneo. Known in Sabah from Labuk Sugut district (e.g., *SAN 128886* and *SAN 130743*) and in Sarawak from Bintulu and Mukah districts (e.g., *S 24533* and type). Also occurring in W Kalimantan.

Ecology. Rare, in mixed dipterocarp forest on deep yellow sands on low hills not far from the coast. Possibly extinct in Sarawak, otherwise critically endangered.

29. **Vatica rynchocarpa** P.S.Ashton

(Greek, *rynchos* = snout, *carpos* = fruit; the beaked nut)

Gard. Bull. Sing. 22 (1967) 270, *op. cit.* (1964) 80 ('19. *Vatica* sp.'), *op. cit.* (1968) 36, *op. cit.* (1982) 365; Anderson *op. cit.* (1980) 133; Coode *et al*. (eds.) *op. cit.* 86. **Type:** *Egon SA 514*, Borneo, Sarawak, Rajang, Nanga Temulang (holotype KEP).

Canopy tree, to 30 m tall, to 1 m diameter. *Exposed fleshy parts*, *leaf blade and venation excepted*, *and ovary shortly sparsely pale greyish brown puberulent*. **Twigs** *c.* 1 mm diameter apically, slender, *terete*, smooth. **Stipules** narrowly hastate, acute, to 2.5 mm long, fugaceous. **Leaves** *thinly coriaceous*, *drying reddish brown*; *blade narrowly elliptic-lanceolate*, *5–8.5 × 1.3–2.5 cm*, *base obtuse*, *margin not revolute*, *apex acuminate with slender acumen to 1 cm long*; *midrib slender*, *raised below*, *obscurely sunken*, *especially* *towards base*, *above*; *lateral veins 10–14 pairs*, with short obscure intermediates, *hardly raised*, well-spaced, arched within margin; *petiole to 0.4 cm long*, *drying black or not.* **Inflorescences** terminal or axillary; rachis singly branched, slender, to 3 cm long. **Flowers** unknown. **Fruits:** pedicels to 7 mm long, slender; *calyx lobes unequal*, *free*, *chartaceaous*, *2 longer lobes spatulate*, *narrowly obtuse*, *to 6.2 × 1.4 cm*, *tapering to 2.5 mm wide at base*, *not becoming reflexed*, 3 shorter ones hastate, acute, to 1.5 × 0.25 cm. **Nuts** *ovoid*, to 1.8 × 0.8 cm, *tapering to 4 mm style remnant*, *glabrous*, drying black.

Distribution. Endemic in Borneo. Recorded in Sabah from Kinabatangan district (e.g., *SAN A 4734*) and in Sarawak from Bintulu, Kapit, Kuching, and Miri districts (e.g., *S 12107*, *S 16568*, *S 27292*, and *S 68711*). Also occurring in Brunei (e.g., *BRUN 3354* and *Niga NN 289*) and Kalimantan (e.g., *Kostermans 10005*).

Ecology. Scattered, in forest on clay alluvium river banks. Vulnerable on account of its habitat loss.

30. **Vatica sarawakensis** F.Heim

(of Sarawak)

Bull. Mens. Soc. Linn. Paris 2 (1891) 109; Slooten *op. cit.* (1927) 106; Masamune *op. cit.* 499; Browne *op. cit.* 101; Ashton *op. cit.* (1963) 252, *op. cit.* (1964) 77, *op. cit.* (1967) 262, *op. cit.* (1968) 36, *op. cit.* (1982) 354; Meijer & Wood *op. cit.* 77; Burgess *op. cit.* 227; Anderson *op. cit.* (1980) 133; PROSEA *op. cit.* 471; Coode *et al.* (eds.) *op. cit.* 86. **Type:** *Beccari PB 3018*, Borneo, Sarawak (holotype P). **Synonyms:** *Retinodendropsis aspera* F.Heim *op. cit.* (1893) 470; *Vatica ramiflora* Slooten *op. cit.* (1927) 118, *p.p.*

Subcanopy tree, to 25 m tall, to 60 cm diameter. *Exposed fleshy parts*, *leaf blade excepted*, *densely pale yellowish- or rufous-brown scabrid-tomentose*; *leaf venation below sparsely so*; *ovary evenly so*; *fruit glabrescent.* **Twigs** to 5 mm diameter apically, stout, ribbed, finely cracked. **Stipules** narrowly hastate, acute, to 15 × 5 mm. **Leaves** thinly coriaceous, drying greyish brown; *blade oblong to obovate*, *22–35 × 7–15 cm*, base obtuse, apex with tapering acumen *to 1.4 cm long*; *lateral veins 15–28 pairs*, *with or without distinct intermediates*, *prominent below*, flat or slightly raised above; *petiole 1–2 cm long*, *to 4 mm diameter*, *stout*, *not drying black.* **Inflorescences** in axillary cluster to 3 or ramiflorous, rarely terminal; rachis much-branched, to 12 cm long. **Flowers:** buds to 8 mm long; calyx shortly reddish brown pubescent, otherwise typical. **Fruits** *glabrous*; pedicels to 2 mm long; *calyx lobes free*, *equal*, oblong-hastate, obtuse or acute, *thickly coriaceous*, *becoming reflexed and somewhat revolute*, to 1.6 × 0.7 cm. **Nuts** *symmetric*, *subglobose to ovoid*, *to 2.5 × 2.5 cm*, acute with short but prominent style remnant, *verrucose-lenticellate*, prominently 3-furrowed.

Vernacular name. Sarawak—*resak daun besar* (preferred name).

Distribution. Endemic in Borneo. Recorded in Sabah from Beaufort, Keningau, Kota Kinabalu, Kuala Penyu, Kinabatangan, Lahad Datu, Sandakan, Sipitang, and Tawau districts (e.g., *SAN 16480*, *SAN 16553*, *SAN 28080*, *SAN 81471*, and *SAN 114894*) and in Sarawak from Kapit, Kuching, Lawas, Lundu, Marudi, and Samarahan districts (e.g., *S 13187*, *S 24225*, *S 37787*, *S 41308*, and *S 60973*). Also known in Brunei (e.g., *Dransfield JD 7491* and *FMS 30382*) and E Kalimantan (e.g., *Argent et al. 93156*, *bb. 7029* and *bb. 10796*).

Ecology. Scattered in mixed dipterocarp forest on clay soils, on low hills, often in floodplains, at altitude to 1400 m. Locally common in Lambir NP and recorded from G. Gading and Mulu NPs; elsewhere vulnerable owing to forest conversion.

Notes. Fruit collected from E Sabah and E Kalimantan are prominently cuspidate, their sepals to 2 cm long, narrow and strongly reflexed, conforming with the type of *V. ramiflora*. Though immature fruit from Sarawak and W and C Kalimantan are similarly cuspidate, the ripe fruit there becomes obtuse, with sepals at most to 7 mm long, conforming with the type of *V. sarawakensis*. Further collections may justify the recognition of two subspecies.

31. **Vatica umbonata** (Hook.*f.*) Burck Fig. 36

(Latin, *umbonatus* = with a central boss; the nut apex)

Ann. Jard. Bot. Buitenz. 6 (1887) 222; Slooten *op. cit.* (1927) 132; Ashton *op. cit.* (1963) 250, *op. cit.* (1964) 78, *op. cit.* (1968) 36, *op. cit.* (1978) 17, *op. cit.* (1982) 349; Meijer & Wood *op. cit.* 320; Burgess *op. cit.* 228; Anderson *op. cit.* (1980) 133; PROSEA *op. cit.* 472; Kessler & Sidiyasa *op. cit.* 115; Coode *et al.* (eds.) *op. cit.* 86. **Basionym:** *Pachynocarpus umbonatus* Hook.*f.*, *op. cit.* (1860) 159, Merrill *op. cit.* (1921) 409. **Type:** *Motley s.n.*, Borneo, Labuan (holotype K). **Synonyms:** *Vatica verrucosa* Burck *op. cit.* 232; *P. verrucosus* (Burck) F.Heim *op. cit.* (1892) 107; *V. blancoana* Elmer *op. cit.* (1912) 1473; *V. cupularis* Slooten *op. cit.* (1927) 132, Browne *op. cit.* 100; *V. ramiflora* Slooten *op. cit.* (1927) 118, *p.p.*

Medium-sized tree, to 30 m tall, to 70 cm diameter, often crooked and shrub-like. *Exposed fleshy parts, leaf blade excepted, and ovary more or less sparsely greyish brown puberulent, caducous except on bud and stipule.* **Twigs** to 3 mm diameter apically, stout, brittle, much-branched, striated, cracked and sometimes thinly flaky. **Stipules** hastate, subacute, to 4 × 2 mm, early caducous. **Leaves** somewhat coriaceous, *drying pale greyish brown*; *blade elliptic*, often asymmetric, *8–16 × 3–6.5 cm*, base cuneate, apex obtuse to shortly *acuminate*; *midrib drying hardly paler than petiole, raised below, flat or raised above, lateral veins 7–8 pairs, without intermediates, raised below, unraised above*, slightly arched; *intercostal venation subscalariform*; *petiole 0.7–1.5 cm long, glabrescent, drying black.* **Inflorescences** axillary or terminal; rachis singly or doubly branched, brittle and falling apart as fruit develop, to 12 cm long. **Flowers:** buds to 10 mm long; calyx curved pubescent; otherwise typical. **Fruits:** pedicels 2–5 mm long; *calyx lobes equal, fused onto nut, as 5 oblong-elliptic corky verrucose plates to 2.6 × 1.8 cm, the whole with the corky verrucose nut apex subglobose, to 3 cm diameter*; or nut *ovoid, acute, with the sepals fused with it in the basal third only and reflexed.*

Vernacular name. Sarawak—*resak air* (preferred name).

Notes. In Sabah and Sarawak, two subspecies, *viz.* subsp. *acrocarpa* and subsp. *umbonata*, are recognised.

Key to subspecies

Nut subglobose, calyx lobes completely fused to it except the verrucose apex, not reflexed...

subsp. **umbonata**

Peninsular Malaysia, Borneo and Palawan (the Philippines). In Sabah recorded from Beaufort, Keningau, Kota Kinabalu, Lahad Datu, Pensiangan, Ranau, Sandakan, Sipitang, and Tenom districts (e.g., *SAN 20492*, *SAN 29348*, *SAN 43156*, *SAN 80943*,

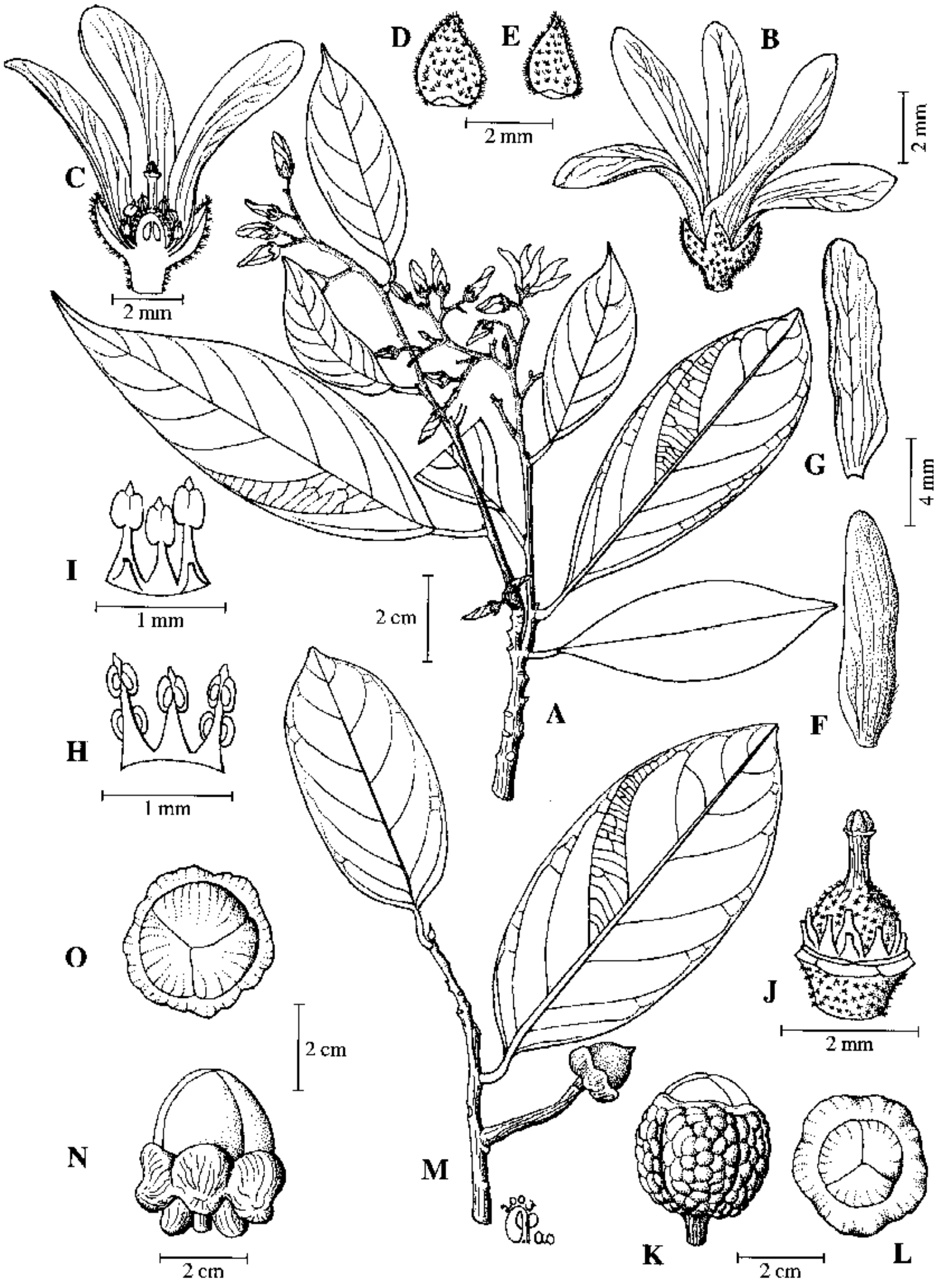

Fig. 36. *Vatica umbonata*, subsp. *umbonata* (A–L) and subsp. *acrocarpa* (M–O). A, flowering leafy twig; B, open flower; C, longitudinal section of open flower; D, abaxial view of outer sepal; E, abaxial view of inner sepal; F, abaxial view of petal; G, adaxial view of petal; H, adaxial view of stamens; I, abaxial view of stamens; J, gynoecium; K, side view of fruit; L, apical view of fruit; M, fruiting leafy twig; N, side view of fruit; O, apical view of fruit. (A–J from *BRUN 1380*, K–L from *S 49284*, M from *SAN 15236*, N–O from *SAN 31657*.)

and *SAN 125248*) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lawas, Lundu, Marudi, Miri, Serian, and Sri Aman districts (e.g., *S 9346*, *S 18567*, *S 28108*, *S 39099*, and *S 68929*). Also occurring in Brunei (e.g., *BRUN 933* and *BRUN 5883*) and Kalimantan (e.g., *Argent et al. 93168* and *Kostermans 5580*).

Locally abundant on alluvium river banks and forming dense monospecific stands; also scattered in mixed dipterocarp forest, usually on poor sandy clay soils and in upper dipterocarp forest, at altitudes to 1300 m. Common on the Kelabit Highlands in Sarawak; not vulnerable.

Nut ovoid, acute, with calyx lobes fused to it in the basal third only and reflexed…………...
subsp. **acrocarpa** (Slooten) P.S.Ashton

(Greek, *across* = terminal, *carpos* = fruit; perhaps referring to the position of the fruit in the type specimen)

Gard. Bull. Sing. 31 (1978) 17, *op. cit.* (1982) 349; PROSEA *op. cit.* 472. Basionym: *Vatica acrocarpa* Slooten *op. cit.* (1942) 241. Type: *Maidin SAN 4298*, Borneo, Sabah, Tawau, Umas-Umas (holotype K).

Endemic in Borneo. In Sabah known from Kinabatangan, Kudat, Labuk Sugut, Lahad Datu, Sandakan, Tawau, and Tenom districts (e.g., *SAN 15236*, *SAN 20014*, *SAN 25452*, *SAN 36146*, and *SAN 91909*). Also occurring in E Kalimantan (e.g., *Kostermans 5334* and *Kostermans 10757*). In forest along river banks or alluvium. Not vulnerable.

32. **Vatica venulosa** Blume

(Latin, *venulosus* = with tiny veins; the delicate leaf venation)

Mus. Bot. Lugd.-Bat. 2 (1852) 32; Merrill *op. cit.* (1921) 409; Slooten *op. cit.* (1927) 78; Masamune *op. cit.* 499; Ashton *op. cit.* (1964) 79, *op. cit.* (1968) 36, *op. cit.* (1978) 17, *op. cit.* (1982) 350; Anderson *op. cit.* (1980) 133; PROSEA *op. cit.* 473; Kessler & Sidiyasa *op. cit.* 115; Coode *et al.* (eds.) *op. cit.* 87. **Type:** *Müller s.n.* (= *RHL Sheet No. 902146794*), Borneo, S Kalimantan, Patai (holotype L). **Synonyms:** *Vatica bancana* Scheff., Nat. Tijd. Ned. Ind. 31 (1870) 348, Meijer & Wood *op. cit.* 305, Burgess *op. cit.* 227; *V. schouteniana* Scheff., *op. cit.* 408; *Dryobalanops schefferi* Hance *op. cit.* 307; *Retinodendron bancanum* (Scheff.) King *op. cit.* 129; *R. kunstleri* King *op. cit.* 129; *V. kunstleri* (King) Brandis *op. cit.* 127; *V. schefferi* (Hance) Brandis *op. cit.* 128; *V. lutea* Ridl., Bull. Misc. Inform. Kew (1926) 60.

Distribution. Sumatra, Peninsular Malaysia, W Java, and Borneo.

Notes. Two subspecies, *viz.*, subsp. *simalurensis* (Slooten) P.S.Ashton and subsp. *venulosa* are recognised but only subsp. *venulosa* occurs in Sabah and Sarawak.

subsp. **venulosa**

Medium-sized tree, to 25 m tall, to 50 cm diameter; bole frequently crooked or leaning. *Exposed fleshy parts, including midrib above and ovary densely persistently pale pinkish brown puberulent*; *blade below caducously so.* **Twigs** to 1.5 mm diameter apically, *terete*, smooth. **Stipules** hastate, to 5 mm long, fugaceous. **Leaves** *thinly coriaceous*, *drying dark reddish brown above*, *pale tawny below*; *blade elliptic*, *ovate-lanceolate to narrowly obovate*, 4–12 × 1.5–5 cm, base cuneate, *margin not revolute*, *apex shortly acuminate*; *midrib prominent below*, *slightly sunken above*; *lateral veins 7–12 pairs*, *without intermediates*, *slender*, *hardly raised below*, *unraised above*, *arched*; *petiole 0.5–0.9 cm long*, *slender*, *not drying black.* **Inflorescences** terminal or axillary; rachis singly branched, ribbed, to 3 cm long. **Flowers:** buds to 13 mm long; calyx pinkish brown pubescent;

otherwise typical. **Fruits:** pedicels to 2 mm long, hidden in the calyx base; *calyx lobes equal*, *free*, *chartaceous*, *ovate acute*, *cordate*, *revolute*, to 3 × 1.3 cm. **Nuts** globose, to 1 cm diameter, with to 1.5 mm long style remnant, pubescent, hidden within calyx.

Vernacular names. Sabah—*resak banka* (preferred name). Sarawak—*resak letup* (preferred name).

Distribution. In Borneo, recorded in Sabah from Kinabatangan and Papar districts (e.g., *SAN 17654* and *SAN 49554*) and in Sarawak from Kuching and Lundu districts (e.g., *Haviland 2440*, *SA 461* and *SA 577*). Also occurring in Brunei (e.g., *Awong AK 13* and *FMS 35704*) and Kalimantan (e.g., *bb. 22920* and *Kostermans 6087*).

Ecology. Apparently very local though possibly overlooked, on clay alluvium banks of sluggish rivers, at low altitudes. Vulnerable owing to its riparian lowland habitat.

33. **Vatica vinosa** P.S.Ashton

(Latin, *vinosus* = coloured like a grape; the tomentum)

Gard. Bull. Sing. 19 (1962) 318, *op. cit.* (1964) 79, *op. cit.* (1968) 37, *op. cit.* (1982) 357; Anderson *op. cit.* (1980) 133; PROSEA *op. cit.* 473; Coode *et al.* (eds.) *op. cit.* 87. **Type:** *Ashton BRUN 764*, Borneo, Brunei, Temburong district, Kuala Sekurop (holotype K; isotype KEP).

Small to medium-sized subcanopy tree, to 30 m tall, to 40 cm diameter. *Exposed fleshy parts*, *including leaf venation below and ovary persistently densely rich vinous-sericeous.* **Twigs** to 1.5 mm diameter apically, slender, *terete*, frequently cracked and flaky. **Stipules** oblong, subacute, to 5 × 2.5 mm, caducous. **Leaves** thinly coriaceous, *bluish green with purple venation and petiole when fresh*, *drying pale greyish brown*; blade elliptic to lanceolate, 6–15 × 1.5–4.5 cm, base narrowly obtuse to cuneate, apex subcaudate, acumen to 1.2 cm long; midrib slender but prominent below, flat above; *lateral veins 12–20 pairs*, with short slender intermediates, *slender but prominent below*, arched; *petiole 0.6–1.3 cm long*, *less than 1 mm diameter*, *slender*, *drying not black.* **Inflorescences** terminal or axillary; rachis singly or doubly branched, terete, to 7 cm long. **Flowers:** buds to 6 mm long; calyx sparsely vinous-sericeous; otherwise typical. **Fruits** vinous cinereous; pedicels to 4 mm long, slender; *calyx lobes free*, *equal*, *obovate*, *revolute*, *incrassate*, *reflexed at base but curving outwards and rotate apically*, to 0.9 × 0.8 cm. **Nuts** *globose*, *to 0.8 mm diameter*, with short style remnant.

Vernacular name. Sarawak—*resak tangkai ungu* (preferred name).

Distribution. Endemic in Borneo. Recorded in Sabah from Keningau, Kinabatangan, Lahad Datu, Pitas, Semporna, Sipitang, and Tawau districts (e.g., *SAN 26184*, *SAN 63072*, *SAN 85017*, *SAN 92359*, and *SAN 121351*) and in Sarawak from Belaga, Bintulu, Kapit, Marudi, and Miri districts (e.g., *S 13326*, *S 22287*, *S 34693*, *S 43707*, and *S 46571*). Also occurring in Brunei (e.g., *BRUN 3383* and *Coode et al. 7849*) and Kalimantan (e.g., *Arifin et al. 7847* and *Kostermans 9146*).

Ecology. In mixed dipterocarp forest on clay rich soils on hills, at altitudes below 300 m. Vulnerable owing to land conversion.

SYMPLOCACEAE

K.G. Pearce

32, Lorong Kumpang 4, Kuching, Malaysia

Desfontaines, Mém. Mus. Hist. Nat. Paris 6 (1820) 9; Merrill, EB (1921) 486, PEB (1929) 248; Masamune, EPB (1942) 607; Backer & Bakhuizen *f.*, FJ 2 (1965) 204; Nooteboom, Leiden Bot. Ser. 1 (1975) 33, FM 1, 8 (1977) 205; Kochummen, TFM 3 (1978) 266; Anderson, CLTS (1980) 327; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 340; Coode *et al.* (eds.), CLBD (1996) 315; Argent *et al.* (eds.), MND-CK 2 (1997) 618.

A monogeneric family comprising about 260 species, widely distributed in tropical and subtropical S America, Asia, New South Wales (Australia), and Pacific Is. In Sabah and Sarawak, 29 species are known, representing about 50% of the total species occurring in the Malesian region.

Taxonomy. While in most recent systems of classification the Symplocaceae is included in the Ebenales, Nooteboom (*op. cit.* 1975) considers the family more closely related to the Cornaceae *s.l.* and the Theaceae, with which it shares primitive wood anatomy and other characters.

SYMPLOCOS Jacq.

(Greek, *symploke* = interweaving; presumably
referring to the indumentum found on parts of some species)

jirah (Iban), *kusi* (Bidayuh, Sadong), *loboh* (Dusun, Kadazan), *periaboh* (Murut)

Enum. Syst. Pl. (1760) 5, 24; Stapf, FMK (1894) 204; Brand *in* Engler, Pflanzenreich 6 (1901) 13; King & Gamble, J. As. Soc. Beng. 74, 2 (1906) 231; Merrill, EB (1921) 486, PEB (1929) 248; Ridley, FMP 2 (1923) 298; Masamune, EPB (1942) 607; Backer & Bakhuizen *f.*, FJ 2 (1965) 204; Nooteboom, Leiden Bot. Ser. 1 (1975) 33, FM 1, 8 (1977) 205; Kochummen, TFM 3 (1978) 266; Anderson, CLTS (1980) 327; Corner, WSTM 3rd edition 2 (1988) 718; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 340; Turner, Gard. Bull. Sing. 47 (1995) 479; Coode *et al.* (eds.), CLBD (1996) 315; Argent *et al.* (eds.), MND-CK 2 (1997) 618. **Synonyms:** *Cordyloblaste* Moritzi, Bot. Zeit. 6 (1848) 606; *Eugeniodes* Kuntze, Rev. Gen. Pl. 2 (1891) 409 & 975.

Shrubs or trees to 35 m tall, 60 cm diameter. **Leaves** *alternate or spiral*, *simple*, *pinnately veined*, *often toothed*, *often drying discolourous or yellow-tinged*. **Stipules** *absent*. **Inflorescences** spicate, racemose or paniculate, rarely flowers solitary, mostly in the axils of upper leaves, sometimes condensed into clusters, sometimes terminal or in the axils of fallen leaves. **Flowers** *subtended by a bract and 2 bracteoles* (rarely several bracts and bracteoles by abortion of flowers), bisexual, radially symmetrical, *those on a single flowering shoot opening almost simultaneously*, sometimes fragrant; calyx tube very short, lobes 3–5, imbricate, persistent; *corolla sympetalous*, 3–5-lobed but divided almost to the base in the subgen. *Hopea*, lobes quincuncially imbricate, white, bluish or purplish; stamens

4 to numerous, either connate into a long monadelphous tube (in subgen. *Symplocos*) or only connate at the very base into monadelphous or into pentadelphous (with the bundles alternate with the petals) tube (in subgen. *Hopea*), inserted on the base of the corolla, anthers globose, 2-loculed, lengthwise dehiscent, introrse; *ovary inferior to slightly semi-inferior*, 2–5-loculed, ovules 2–4 in each locule, pendulous, anatropous-epitropous or amphitropous, unitegmic, tenuicellular, style 1, stigma punctiform or peltate. **Fruit** *a monopyrenous drupe crowned by the persistent calyx lobes*, cylindrical to globose, flask-shaped or spindle-shaped; *in many species epicarp blue to deep violet*, *sometimes black*; mesocarp usually thin, sometimes thick and then often quite hard; stone sculptured or longitudinally ridged, occasionally smooth. **Seeds** straight or curved, one in each developed locule; embryo straight or curved, cotyledons short, linear; endosperm copious.

Ecology. In Sabah and Sarawak, species of *Symplocos* occur from sea level to *c.* 3600 m altitude. At lower altitudes, the genus is represented mostly by shrubs and small to medium-sized understorey trees and at higher altitudes by microphyllous, dwarf shrub species. Some species have a considerable altitudinal range while others are restricted to low-lying land or high altitudes. Many are found in more than one habitat although often showing a preference for a particular habitat. Some species are distinctly rare (e.g. *S. brachybotrys*, *S. colombonensis*, *S. deflexa*, and *S. gambliana*) while a few are common and widespread (e.g. *S. adenophylla*, *S. celastrifolia*, *S. crassipes*, *S. laeteviridis*, and *S. polyandra*). Self-pollination has been reported in a taxon from Java, and various insects including bees and bumble bees have been reported as visiting flowers, which in some species are fragrant and in some species open at night. Fruits of *S. celastrifolia* are water-dispersed.

Uses. In Sabah and Sarawak, species of *Symplocos* are hardly used. There are rare reports of various species providing timber and firewood, being used in magic (*S. cochinchinensis*) and to cure eye sores (*S. fasciculata*). Elsewhere in Borneo, a few species have been used as a mordant during dyeing, as the tissues (bark and leaves) contain aluminium. *Symplocos fasciculata* is used thus for dyeing rattans by the Dayaks of Borneo, while *S. adenophylla* in W Borneo is known locally as *kayu kain*—the name presumably alluding to its use in dyeing cloth. The Dayaks have extracted salt from the wood ash of *S. odoratissima* and in W Java the inner bark of this species is pulped and rubbed on the gums to treat thrush.

Taxonomy. *Symplocos* has two subgenera, *viz*. subgen. *Symplocos* and subgen. *Hopea*, which are differentiated on combinations of characters (connateness of corolla lobes, leaf arrangement, dry leaf colour and whether the seed and embryo are straight or curved). In Sabah and Sarawak, subgen. *Symplocos* is only represented by *S. henschelii* and *S. pendula*, and the other species belong to subgen. *Hopea*. Some *Symplocos* species show considerable morphological variation which is largely satisfactorily circumscribed by the recognition of subspecies and varieties.

Key to *Symplocos* species

1. Older parts of twigs with horizontal cracks……………………………………………2
   Older parts of twigs without horizontal cracks…………………………………………5

2. Twigs with pale or prominent and raised scars of fallen leaves…………………….…3
Twigs without such scars……………………………………………………………4

3. Twigs straight. Leaves ovate to elliptic, margin sharply to obscurely black-tipped toothed. Petiole 3–4 mm long. Fruits *c.* 1 × 0.5 cm…………….………………………...

S. brachybotrys Merr.

(Latin, *brachium* = a branch, Greek, *botrys* = a bunch of grapes; the form of the infructescence)

J. Str. Br. Roy. As. Soc. 76 (1917) 110, *op. cit.* (1921) 486; Masamune *op. cit.* 608; Heine, Pfl. Samml. Clemens Kinabalu (1953) 87; Nooteboom *op. cit.* (1975) 134, *op. cit.* (1977) 243; Anderson *op. cit.* 327. Type: *Clemens 10961*, Borneo, Sabah, Mt. Kinabalu, Marai Parai spur (holotype BO).

Shrub to 1 m tall. *Twigs straight*, *marked with pale or prominent and raised scars of fallen leaves*; young parts finely striate with scattered, appressed hairs; *older parts with horizontal cracks*, glabrescent. Leaves spirally arranged, thin-coriaceous, slightly glossy below, drying olive-brown, both surfaces sparsely appressed-hairy to glabrescent; *blade ovate to elliptic*, 3.5–7 × 1.4–3.6 cm, base acute to rounded to barely cordate, *margin* plane to slightly recurved, *sharply to obscurely black-tipped toothed*, apex short-acuminate with acumen to 0.7 cm long or bluntly obtuse; midrib channelled above; lateral veins 6–9 pairs, distinct below, branching and joining near the margin to form a looped, double intramarginal vein; intercostal venation closely reticulate, raised on both surfaces but especially distinct below; *petiole 3–4 mm long*, deeply channelled to the base, rugulose. Inflorescence a short spike; axis to 0.7 cm long, 1–3-flowered, appressed-pubescent; bracts caducous, densely appressed golden-pilose, 2–4 mm long. Flowers sessile; calyx golden pilose, divided into elliptic lobes *c.* 3 mm long; corolla white in bud, *c.* 6 mm long; stamens *c.* 100; disk inconspicuous, glabrous; ovary *c.* 1 mm high, golden pilose, style glabrous, *c.* 4 mm long. *Fruits* ovoid to ellipsoid, *c. 1 × 0.5 cm*, intense indigo-blue.

Endemic in Borneo. In Sabah, known only from Mt. Kinabalu, Kota Belud district (e.g., *Clemens 32525*). In Sarawak, recorded from G. Berumput, Lundu district in the extreme SW (e.g., *S 47366*). In montane forest at 1300–1800 m altitude.

Twigs curved or crooked. Leaves elliptic, broadly elliptic to obovate to almost orbicular; margin distantly blunt-toothed. Petiole (1–)4–10 mm long. Fruits *c.* 1 × 0.7 cm………………………………........…………………………..…**20. S. pendula**

4. Twigs straight. Leaves obovate-elliptic, margin recurved from midpoint to base, sharply black-gland tipped denticulate from midpoint to apex, apex obtuse to rounded; lateral veins 4–6 pairs. Inflorescence axis 1.4–3 cm long…......**4. S. buxifolia**

Twigs curved to zigzag. Leaves ovate-elliptic, margin obscurely toothed and revolute except sometimes at apex, apex acute, shortly apiculate; lateral veins (6–)7–8 pairs. Inflorescence axis 0.2–0.5(–0.9) cm long…………......……………..**5. S. buxifolioides**

5. Twigs and both leaf surfaces glabrous. Leaf margin entire…………………………..…6
Either twigs or one or both leaf surfaces hairy. Leaf margin toothed or crenulate, occasionally entire…………………………………………………………………8

6. Petiole to 4 mm long. Leaves to 2.5 cm wide…………………....….…**3. S. borneensis**
Petiole at least 5 mm long. Leaves at least 2.5 cm wide…………………………..……7

7. Petiole at most 10 mm long. Lateral veins 6–8 pairs. Inflorescences to 6 cm long……..…

S. gambliana Brand

(James Sykes Gamble, 1847–1925, forester and botanist of the Indian Forest Service)

Bull. Herb. Boiss. 2 (1906) 748; Merrill *op. cit.* (1921) 487; Masamune *op. cit.* 609; Nooteboom *op. cit.* (1975) 195, *op. cit.* (1977) 260; Anderson *op. cit.* 328. Type: *Haviland 1954*, Borneo, Sarawak, near Kuching (BM, BO, K). Synonym: *Symplocos havilandi auct. non* Brand: King & Gamble *op. cit.* 250.

Twigs straight, *older parts grooved*, *glabrous*. *Leaves* slightly glossy above, *glabrous*, drying olive-yellow-green; *blade* more or less elliptic, *6–9 × 3–4.5 cm*, base acute, attenuate, *margin entire*, recurved, apex abruptly obliquely acuminate, folded when dry; *lateral veins 6–8 pairs*, joining into a looped, faintly prominent intramarginal vein; *petiole 5–10 mm long*, drying dark. *Inflorescence a lax spike or basally branched raceme to 6 cm long*; axis glabrous; bracts and bracteoles soon caducous. Flowers *c.* 10; pedicel less than 1 mm long; calyx entirely divided into semi-orbicular, ciliate, 0.75–1.5 mm long lobes, lobe margin markedly paler than the rest of the calyx and the ovary; corolla white when fresh, sweet-scented, ciliolate, often with some minute hairs on the outside, *c.* 5 mm long; stamens *c.* 50; disk 5-glandular; ovary glabrous, *c.* 1 mm high, style minutely pilose at the base, otherwise glabrous, *c.* 4 mm long. Fruits unknown.

Endemic in Sarawak. Only known from the type.

Petiole 6–35 mm long. Lateral veins 8–13 pairs. Inflorescences 5–17 cm long………… ……………………………………........…………..…**18. S. odoratissima** (in part)

8. Twigs densely, minutely rufous to dark brown tomentose, drying dark grey to black. Petiole usually drying dark grey to black. Leaf margin bearing densely set but hardly raised pellucid glands (these occasionally absent) thus appearing shallowly toothed or crenulate. Similar glands occur on flanges of petiole at least near junction with leaf. Leaf apex attenuate with curved acumen to 3 cm long……........……**1. S. adenophylla**

Twigs not densely rufous to dark brown tomentose, or if densely rufous to dark brown tomentose then glands, if present, not pellucid and acumen, if present, usually less than 2 cm long………………………………………………………………………………9

9. Leaf apex acuminate, acumen blunt-tipped. Inflorescences 5–17 cm long. Fruits obliquely ovoid to almost globular, *c.* 2.1 × 1.7 cm…..........**18. S. odoratissima** (in part)

Leaf apex attenuate, obtuse, rounded or abruptly, shortly or sharply acuminate (apically rounded in *S. cochinchinensis* subsp. *laurina*). Inflorescences at most 9.5 cm long, often much shorter. Fruits smaller, if 2.1 cm or longer then ellipsoid, ovoid or obovoid but not almost globular…..10

10. Leaf margin entire……………………………………………………………..…11

Leaf margin toothed…………………………………………………………..…12

11. Petiole 4–13 mm long. Leaf apex acuminate. Lateral veins 5–9 pairs. Fruits to 5 × 2.6 cm………………………………………….............……………..…**15. S. henschelii**

Petiole 15–32 mm long. Leaf apex rounded to bluntly obtuse. Lateral veins 11–14 pairs. Fruits to 1.2 × 0.7 cm…………………………...………………**21. S. polyandra**

12. Twigs weakly curved. Leaf margin usually distinctly and coarsely crenate with black glandular teeth. Leaves drying olive-green, often with a pattern of fine, dark marks

parallel to the veins, to almost black above, usually considerably paler below…………
……………………………………..........………………………..…**6. S. celastrifolia**
Twigs straight, crooked or obscurely zigzag, if curved then leaf margin almost entire, obscurely toothed or dentate, but not distinctly and coarsely crenate. Leaves not drying with fine dark marks parallel to the veins……………………...………………………13

13. Midrib flat or raised above, rarely flat with impressed channel near the base. Leaves drying yellow-brown, slightly glossy above…………………..........…..…**2. S. anomala**
Midrib channelled above. Leaves drying not as above……………………………..…14

14. Petiole terete, swollen along its length. Midrib swollen from junction with petiole for a distance to 9 mm. Lateral veins prominent below, looping and joining to form a distinct intramarginal vein at least 5 mm distant from the leaf margin. Fruits cylindrical with apex narrowed then expanded below persistent, erect calyx lobes……………………….

S. leochaii P.Chai
(Leo Chai Chia Liang, former Director of Sarawak Forestry Department)
Sandakania 7 (1996) 63. Type: *Chai S 33926*, Borneo, Sarawak, Lubok Antu district, Lanjak-Entimau Wildlife Sanctuary, Bt. Peninjau (holotype SAR; isotypes K, L).

Treelet to 4 m tall. Bark brown. *Twigs slightly zigzag*, to 4 mm diameter, *glabrous*; *older parts without horizontal cracks*. *Leaves* spirally arranged, chartaceous, *glabrous or with scattered*, *appressed hairs below*, *drying buff to olive-green*; blade ovate to narrowly elliptic, 10–32 × 4.5–10 cm, base obtuse to slightly cordate, *margin* plane to slightly recurved, *finely serrate with shallow*, *brown-gland-tipped teeth*, *apex acuminate*, *acumen to 2.5 cm long*; *midrib deeply*, *finely channelled above*, pilose below; *lateral veins* 6–16 pairs, *prominent below*, *looping and joining into a distinct*, *intramarginal vein at least 5 mm distant from the margin*; intercostal venation scalariform-reticulate, distinct, close, raised on both surfaces; *petiole* 4–12 mm long, *terete*, *swollen along its length with the swelling sometimes continuing for up to 9 mm along the base of midrib*, rugulose. *Inflorescences simple or basally branched spikes to 3.7 cm long*; axis densely golden pilose; bracts lanceolate, keeled, persistent after anthesis or not, to 3.5 mm long; bracteoles persistent or not, 0.8–1.2 mm long. Flowers closely set, sessile; calyx divided almost to the base, to 1.5 mm long, lobes ovate; corolla white when fresh, *c.* 5 mm long; stamens numerous; disk pilose; ovary golden or white pilose, to 1 mm high, style glabrous, *c.* 4 mm long. *Fruits cylindrical*, *c. 1.6 × 0.5 cm*, *narrowing then expanding below persistent*, *erect calyx lobes*, slightly ridged, sparsely short-pilose, pale greenish-white when young, becoming reddish, ripening blue.

Endemic in Sarawak. Known only from Bt. Peninjau, Lanjak-Entimau Wildlife Sanctuary, Lubok Antu district (e.g., *S 77540*, *S 78224* and the type collection) and Sg. Balui, Belaga district (e.g., *Zainuddin AZ 5700*). In primary or logged-over mixed dipterocarp forests, at 500–900 m altitude, on ridges or steep slopes on yellow sandy clay soil.

Petiole, midrib and lateral veins not as above. Intramarginal vein, if present, distinct or faint. Fruits ovoid, ellipsoid, obovoid or cylindrical-ovoid or flask-shaped………....15

15. Leaf apex with acumen to 2.2 cm long. Lateral veins ascending and curved for most of their length. Bracts broadly ovate or elliptic to semi-orbicular, hairy. Infructescences mostly with 1–2 fruits. Fruits to 1.5 × 0.8 cm, with persistent calyx lobes erect to incurved, forming a beak……………………….........………………….…**11. S. crassipes**
Not with the above combination of characters……………………………………….…16

16. Lateral veins fine, indistinct above, looping, branching and joining to form a faint, sometimes double, intramarginal vein. Inflorescences fascicles of several branched racemes, a set of immature inflorescences sometimes present above and distinct from a set of mature inflorescences below; bracteoles partly appressed or fused to the ovary…. ………………………………………………………..........……..…**13. S. fasciculata**
    Not with the above combination of characters…………………………………..…17

17. Leaf apex acuminate to attenuate, acumen to 2 cm long, often curved. Lateral veins indistinct above, curved towards the margin, forming a distinct, looped intramarginal vein sometimes with a second, less distinct intramarginal vein. Intercostal venation lax. Inflorescences simple or basally branched spikes or racemes to 2.7 cm long. Calyx lobe margin paler than other parts of calyx and ovary………..........…..…**19. S. ophirensis**
    Not with the above combination of characters…………………………………18

18. Twigs straight, curved or zigzag. Petiole at least 5 mm long……………………..…19
    Twigs zigzag. Petiole up to 4 mm long……………………………………………..…25

19.
    Leaves drying markedly pale yellow-green or pale grey-green......................……..…20
    Leaves drying olive-yellow, olive-green, olive-brown, olive-grey or brown to almost black; if yellow-green then not markedly pale……………………….……………..…23

20. Young twigs grooved to angular. Petiole 18–40 mm long. Fruits inversed pyriform…… ………………………………………………….........………..…**14. S. goodeniacea**
    Young twigs grooved and/or ridged. Petiole 5–20 mm long. Fruits ampulliform or ellipsoid or ovoid………………………………………………………………..……21

21. Lateral veins not forming a distinct intramarginal vein except sometimes towards the leaf apex……………………………………...........………………..…**23. S. tricoccata**
    Lateral veins joining to form an intramarginal vein 4 mm or more from the leaf margin ……………………………………………………………………………………..…22

22. Leaf base decurrent on petiole as sharp flanges which sometimes continue as fine ridges on twigs; acumen to 3 cm long. Lateral veins finely raised above or sunken so that leaf appears bullate. Intramarginal vein at least 4 mm from the leaf margin. Bracts persistent..……………………………………..........…………**16. S. iliaspaiensis**
    Leaf base slightly decurrent on petiole but not as sharp flanges; acumen to 2 cm long. Intramarginal vein 6–12 mm from the leaf margin at its furthest point. Bracts caducous ……………………………………………………….........…..…**10. S. costatifructa**

23. Twigs glabrous or with scattered weak hairs to more than 2 mm long. Fruits ellipsoid-ovoid or ellipsoid-obovoid, *c.* 3.5(–4) × 2 cm……..........……………**7. S. cerasifolia**
    Twigs densely rufous tomentose to almost glabrous. Fruits ampulliform, ovoid or globose; at most to 1.3 × 0.8 cm……………………………………………………24

24. Twigs terete, coarsely striate. Inflorescences spikes or racemes bearing numerous flowers. Bracts persistent after anthesis…………........……..…**8. S. cochinchinensis**
    Twigs deeply grooved, finely striate. Inflorescences spikes bearing 5–10 flowers, appearing cone-like in bud. Bracts caducous at anthesis…..........……**22. S. rubiginosa**

25. Shrub or tree to 23 m tall, 20 cm diameter. Inflorescences commonly arising simultaneously from the axils of 6–12 or more leaves at the shoot apex……………….. ……………………………………………………..................…**17. S. laeteviridis**
Shrub or tree to 10 m tall. Inflorescences otherwise……......……………………...…26

26. Leaves elliptic. Bracts persistent……………………………………………………27
Leaves ovate. Bracts caducous or sometimes persistent (in *S. johniana*)…………..…28

27. Leaves alternate...

S. trichomarginalis Noot.
(Greek, *trichos* = hair, Latin, *margo* = border; the hairy leaf margin)
Leiden Bot. Ser. 1 (1975) 287, *op. cit.* (1977) 272. Type: *Clemens 33116*, Borneo, Sabah, Mt. Kinabalu, Marai Parai (holotype L; isotypes BM, BO, G).
Shrub 1–4 m tall. Twigs often zigzag, *appressedly brown pilose*. *Leaves alternately arranged*, *sparsely appressedly pilose below*; *blade elliptic*, 2–3.5 × 1.25–1.75 cm, base cuneate to rounded, *margin* recurved, *finely glandular dentate*, conspicuously densely appressedly brown-pilose below (as is midrib below), *apex acuminate*; lateral veins 5–7 pairs; *petiole 2–4 mm long*. Inflorescences: *bracts* brown-pilose, often several, *persistent*, the 2 uppermost 3–5 × 1–3 mm. Flowers solitary, pedicel to 1 cm long; calyx (and ovary) loosely appressed-pilose, divided into narrowly elliptic, acute lobes *c.* 3 mm long; corolla *c.* 4 mm long; stamens *c.* 50; disk glabrous; ovary *c.* 1 mm high, style glabrous, *c.* 5 mm long. *Fruits* sparsely pilose, ellipsoid to ovoid, *c. 0.9 × 0.4 cm*, green to deep indigo when ripe.
Endemic in Sabah. Known only from Mt. Kinabalu, Kota Belud district (e.g., *Clemens 32559*, *Clemens 40028* and the type), at 1500–2400 m altitude in open places and forest edges.

Leaves spirally arranged………………………………………………**12. S. deflexa**

28. Shrub to 5 m tall. Leaf margin plane to recurved. Lateral veins joining into a looped intramarginal vein. Inflorescence a 1-flowered receme..

S. johniana Stapf
(Spenser St. John, secretary to Rajah James Brooke, *c.* 1848)
FMK (1894) 206; Brand *op. cit.* (1901) 65; Merrill *op. cit.* (1921) 487; Masamune *op. cit.* 609; Heine, Pfl. Samml. Clemens Kinabalu (1953) 88; Nooteboom *op. cit.* (1975) 208, *op. cit.* (1977) 261. Type: *Haviland 1161*, Borneo, Sabah, Ranau district, Mt. Kinabalu (holotype K; isotype BO).
Shrub less than 5 m tall. *Twigs sometimes obscurely zigzag*; young parts striate, with striation obscured by more or less dense, oblique to patent rusty hirsute tomentum; older parts glabrescent. *Leaves* spirally or alternately arranged, chartaceous to thin-coriaceous, glabrous above, *rather densely appressed to patent pilose below*, or only midrib and veins hairy, *drying warm-brown to olive-brown*; *blade ovate*, 1.2–7 × 0.6–3.5 cm, base rounded to cordate, *margin* plane to recurved, *with coarse*, *sharp teeth* on at least some leaves, *apex acuminate to attenuate*, *acumen c. 1 cm long*, often curved; *midrib deeply*, *finely channelled above*, *pilose towards base*; *lateral veins* 3–6(–8) pairs, *curved from the base*, *usually markedly impressed above*, *joining into a looped intramarginal vein*; *intercostal venation lax*, *more or less transverse to lateral veins*, *reticulations fine*, *close*; *petiole 1–3 mm long*, *terete*, indumentum as twig. *Inflorescence a 1-flowered raceme*; *axis to 4 mm long* at anthesis, rusty pilose; *bracts and bracteoles persistent or not in fruit*, *loosely appressed rusty hirsute*. Flowers with pedicel *c.* 1 mm long; calyx rusty long-pilose, ciliate, with lobes to 1.5 mm long; corolla white

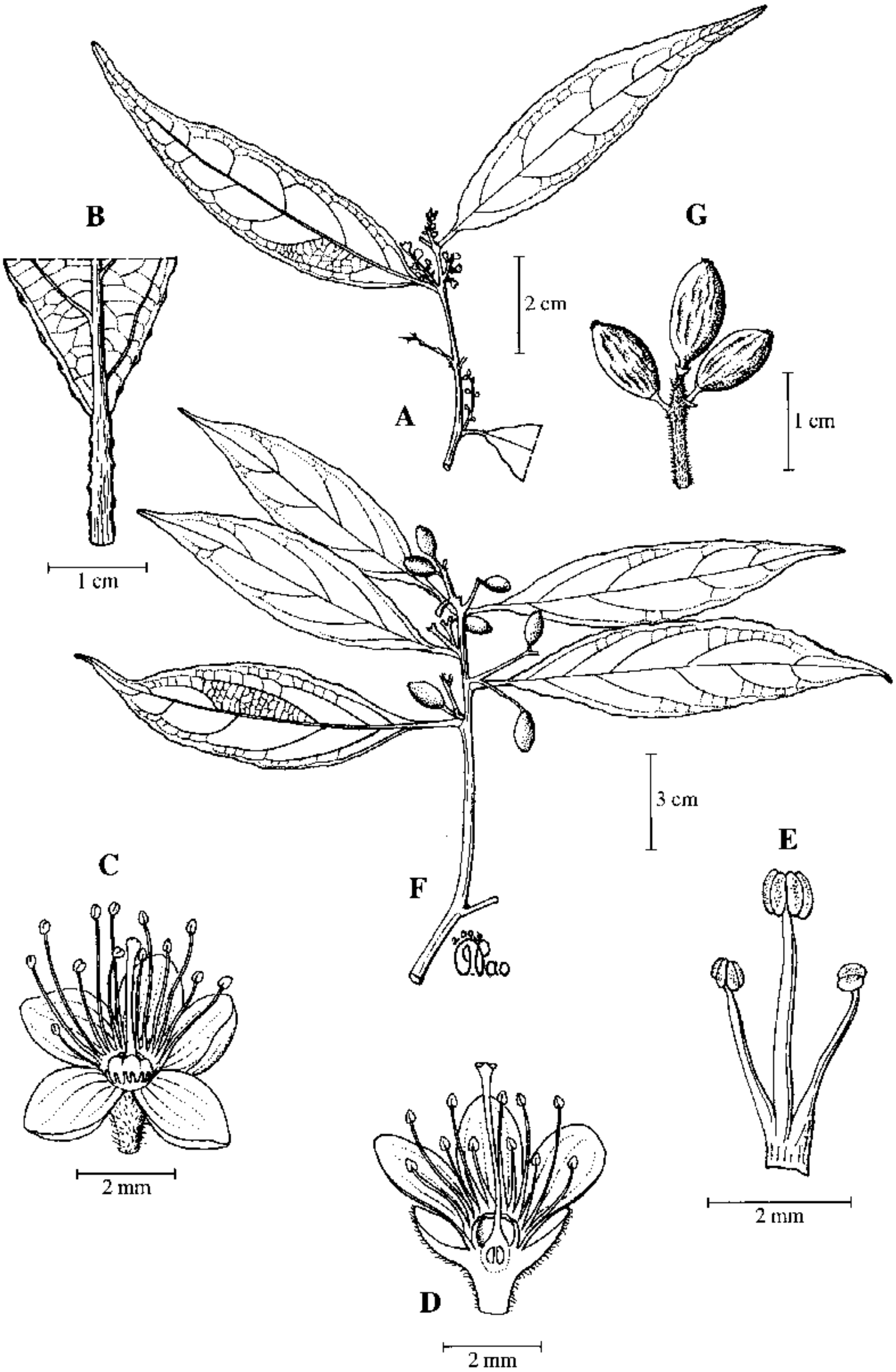

Fig. 1. *Symplocos adenophylla.* A, flowering leafy twig; B, detail of venation and gland on lower leaf surface; C, open flower; D, longitudinal section of open flower; E, stamens; F, fruiting leafy twig; G, infructescence. (A and C–E from *SPN 4065*, B from *S 26434*, F–G from *Sugau JBS 11*.)

when fruiting leafy twig; G, infructescence. (A from *SNP 4065*, B from *S 26434*, C–E from *SNP 4065*, F–G from *Sugau JBS 11*.)

fresh, *c.* 5 mm long; stamens 60–90; disk stellate, densely hirsute; *ovary c.* 1 mm high, *somewhat obscured by bracteoles and rusty long pilose tomentum*, style glabrous, *c.* 6 mm long. *Fruits cylindrical-obovoid*, *slightly curved or narrowly flask-shaped*, *c. 1.3 × 0.4 cm*, short-hairy, brilliant dark shiny blue when ripe, *with erect calyx lobes*.

Endemic in Borneo. In Sabah, known from Mt. Kinabalu in Ranau district and G. Lotung in Kinabatangan district (e.g., *Clemens 28795*, *RSNB 4953*, *SAN 76486*, *SAN 83258*, and *SPN 5168*) and in Sarawak, from Batu Lawi, Marudi district (e.g., *S 50549* and *S 50904*). Also occurring in E Kalimantan on G. Kemul, W Kutei (e.g., *Endert 3933*). In lower to upper montane forests at 1400–2500 m altitude, in the crevices of granite rocks in damp, shady places.

Shrub or treelet to 10 m tall. Leaf margin recurved to revolute; lateral veins merging with the reticulations towards the margin or forming an indistinct intramarginal vein. Inflorescence a 1–4-flowered raceme……………………………………………29

29. Petiole 3–4 mm long. Raceme 3-flowered. Pedicels 1–5 mm long. Calyx appressedly brown pilose………………………………………………**9. S. colombonensis**

Petiole channelled above, 1–2 mm long. Flowers solitary, pedicel 5–12 mm long, or a raceme with up to 4 very shortly pedicellate flowers. Calyx lobes sparsely pilose to glabrous…………………………………………………..…**24. S. zizyphoides**

1. **Symplocos adenophylla** Wall. *ex* G.Don Fig. 1.

(Greek, *adeno* = gland, *phulon* = leaf; the glandular leaf margin)

Gen. Hist. 4 (1837) 3; C.B. Clarke *in* Hooker *f.*, Fl. Brit. Ind. 3 (1882) 575; Stapf *op. cit.* 204; Brand *op. cit.* (1901) 48; King & Gamble *op. cit.* 240; Merrill, Philip. J. Sci. 2 (1907) Bot. 298, *op. cit.* (1921) 486; Ridley *op. cit.* (1923) 303; Masamune *op. cit.* 607; Nooteboom *op. cit.* (1975) 121, *op. cit.* (1977) 239; Kochummen *op. cit.* 268; Anderson *op. cit.* 327; Whitmore, Tantra & Sutisna *op. cit.* 340; Turner *op. cit.* 479; Coode *et al.* (eds.) *op. cit.* 315. **Type:** *Wallich Cat. 4427A*, Peninsular Malaysia, Penang (holotype K-W; isotypes BM, CGE, E, FI, K, MEL, NY, W). **Synonyms:** *Symplocos bancana* Miq., Fl. Ned. Ind., Suppl. 1 (1861) 476; *S. iteophylla* Miq. *op. cit.* (1861) 476; *Eugeniodes adenophyllum* (Wall. *ex* G.Don) Kuntze *op. cit.* 410; *S. adenophylla* Wall. *ex* G.Don var. *virgata* Wall. *ex* Brand *op. cit.* (1901) 48; *S. constricta* Brand *op. cit.* (1901) 41; *S. beccarii* Brand *op. cit.* (1901) 49; *S. adenophylla* Wall. *ex* G.Don var. *atrata* Brand *op. cit.* (1906) 748; *S. fulvosa* King & Gamble *op. cit.* 2; *S. adenophylla* Wall. *ex* G.Don var. *merrittii* Brand, Philip. J. Sci. 3 (1908) Bot. 7; *S. palawanensis* Brand *op. cit.* (1908) 10; *S. pruniflora* Ridl., J. Fed. Mal. St. Mus. 4 (1909) 46; *S. brandii* Elmer, Leafl. Philip. Bot. 4 (1912) 1477; *S. pahangensis* Brand *in* Fedde, Rep. 14 (1916) 326; *S. adenophylla* Wall. *ex* G.Don var. *montana* Ridl. *op. cit.* (1923) 303. (For further synonyms, *cf.* Nooteboom *op. cit.* (1975) 122).

Shrub or tree, 15–30 m tall, 20–40 cm diameter. **Bark** smooth, often mottled, pale grey to dark brown or black; inner bark pale yellow, brown, pink or green. **Sapwood** yellow to brown, medium hard. **Twigs** straight, terete, (2–)3–4(–4.5) mm diameter; *young parts finely striate*, *densely minutely rufous to dark brown tomentose*, grey to red-brown; *older parts almost smooth*, *glabrescent*, *dark grey to black*. **Leaves** spirally arranged, thin-coriaceous, slightly glossy above, *sparsely puberulous to glabrous on both surfaces*, drying pale olive-green to rich chocolate-brown; blade ovate-elliptic, (4–)5–10(–15.5) × (0.7–)1.5–3(–5.5) cm, base slightly asymmetric, shortly attenuate, *margin* slightly recurved, *usually appearing very shallowly toothed or crenulate from base to apex due to the presence of densely set but* *hardly raised pellucid glands*, *apex attenuate*, *acumen curved*, *to 3 cm long*; midrib finely channelled above, sharp below; lateral veins (5–)6–7(–11) pairs, obscure above, distinct below, distant, looping and joining to form an intramarginal vein; intercostal venation finely reticulate, distinct below; *petiole* (4–)6–9(–11) mm long, shallowly channelled almost to the base above, *flanges glandular as the leaf margin at least near junction with the blade*, glabrous or if pubescent the indumentum as that of the twig, slender, rugulose, *usually drying same colour as twig*. **Inflorescences** racemes or panicles with up to 3 basal branches, 0.9–4(–6) cm long, many-flowered; axis indument as twig, bracts, bracteoles and ovary; bracts and bracteoles with pellucid glands on margin, persistent in fruit, minute, to 1.2 mm and 0.5–0.8 mm long respectively. **Flowers:** upper ones sessile, lower ones sometimes shortly pedicellate (pedicels to 2.5 mm long), minute; calyx lobes triangular with rounded apex, more or less densely rufous or dark brown puberulent-tomentose but less densely so towards the sometimes pellucid-glandular margin, 0.3–0.7 mm long; corolla lobes oblong-ovate, white to yellow when fresh, fragrant, glabrous, to 3 mm long; stamens 25 or more, anthers yellow when fresh; disk glabrous; style glabrous, to 2 mm long. **Infructescences** often with rather few fruits. **Fruits** cylindrical-ellipsoid to slightly obovoid, to 1 × 0.6 cm, obscurely ridged, sparsely puberulent to glabrous, ripening blue, with remains of the calyx lobes incurved over the hardly sunken disk and style-base.

Vernacular names. Sabah—*jiak* (Malay), *loboh* (Kadazan), *pelawan-pelawan* (Sandakan). Sarawak—*jirah*, *jirak*, *kabang* (Iban).

Distribution. China (including Hainan), Indo-China, Thailand, throughout Malesia, except Java, the Lesser Sunda Is. and New Guinea. In Sabah, common and widely distributed from Kota Belud to Sipitang districts in the W to Ranau, Keningau, Kinabatangan, Lahad Datu, Sandakan, and Tambunan districts in the E (e.g., *RSNB 4459*, *SAN 53963*, *SAN 75934*, *SAN 117290*, and *SAN 140807*). In Sarawak, somewhat scattered, occurring in Belaga, Kuching, Lawas, Limbang, Lubok Antu, Lundu, Marudi, and Miri districts (e.g., *S 8430*, *S 12055*, *S 21441*, *S 26306*, and *S 46837*). Also occurring in Bt. Belalong, Brunei (e.g., *BRUN 3155*) and in C and SE Kalimantan (e.g., *Burley*, *Tukirin et al. 3275*, *Kostermans 10173* and *Mogea 3842*).

Ecology. In *kerangas* forest on coastal and lowland sites but more commonly in montane forest or high *kerangas* forest at 1300–3000 m altitude, with a marked preference for hillsides and exposed ridges and summits, preferring poor, sandy soils and occasionally found on limestone and ultrabasic soils.

Uses. The timber is locally used for beams and the bark for dyeing cloth in W Borneo, where it is known as *kayu kain*.

2. **Symplocos anomala** Brand

(Greek, *anomalos* = not according to rule; the midrib is raised or flat above, unlike other *Symplocos* species)

Bot. Jahrb. 29 (1900) 259, *op. cit.* (1901) 67; Nooteboom *op. cit.* (1975) 126, *op. cit.* (1977) 239; Kochummen *op. cit.* 268; Anderson *op. cit.* 327; Whitmore, Tantra & Sutisna *op. cit.* 341; Turner *op. cit.* 479; Argent *et al.* (eds.) *op. cit.* 618. **Lectotype** (Nooteboom, 1975)**:** *Henry 7094*, E China, Szechuan (hololectotype E; isolectotype K). **Synonyms:** *Symplocos concolor* Brand *op. cit.* (1901) 65; *Bobua anomala* (Brand) Migo, Bot. Mag. Tokyo 56 (1942) 267. (For further synonyms, *cf.* Nooteboom *op. cit.* (1975) 126).

Shrub or tree to 30 m tall, to 50 cm diameter. **Bark** smooth, grey or brown; inner bark yellow, pink or brown. **Sapwood** yellow to white, hard. **Twigs** *straight*, *sometimes crooked or slightly zigzag*, *terete to irregularly grooved*, to 5.5 mm diameter, *coarsely striate*, *shortly*, *densely*, *appressedly pale brown to rufous pilose*, pale to dark brown; *older parts glabrescent.* **Terminal buds** densely appressedly pale-brown pilose. **Leaves** spirally arranged, chartaceous to thin-coriaceous, *slightly glossy above*, *glabrous or virtually so*, *drying yellow-brown*; blade elliptic to ovate-elliptic, 3.5–10.5 × 1.5–4 cm, base shortly attenuate to cuneate, decurrent as flanges on petiole, *margin* slightly recurved, *obscurely*, *minutely dark-glandular toothed*, *apex sharply acuminate*, *acumen slightly curved*, *to 1.5 cm long*; *midrib flat or raised above*, glabrous or if with hairs, these often located in the channel; lateral veins 8–13 pairs, branching and joining towards margins to form an indistinct double intramarginal vein; intercostal venation finely reticulate, forming a loose network below; petiole (2–)4.5–6(–7.5) mm long, narrowly flanged to base, glabrous throughout or shortly pilose along axis above and sparsely pilose below, rugulose, drying same colour as twig or black. **Inflorescences** in the axils of upper leaves, *racemes to 1.5 cm long*, 3–7-flowered; axis, bracts, bracteoles, calyx and ovary densely, shortly, pale brown appressed-pilose; bracts and bracteoles persistent, minute. **Flowers:** pedicels to *c.* 2 mm long; calyx tube to 0.5 mm long, lobes shallow, rounded, ciliolate, to 0.5 mm long; corolla lobes ovate, white when fresh, glabrous, *c.* 3 mm long; stamens 50 or more; disk shortly hairy; ovary *c.* 0.8 mm high, style glabrous. **Infructescences** to 2.6 cm long. **Fruits** 1–3 per infructescence, *ellipsoid-obovoid*, *to 1.5 × 1 cm*, faintly ridged or not, sparsely, shortly pilose to glabrescent, ripening purple to black, drying dark brown, with brown to black, persistent, erect to apically incurved calyx lobes and persistent style base.

Distribution. China (including Hainan), Japan, Ryu Kyu Is., Taiwan, Myanmar, Indo-China, Thailand, N Sumatra, Peninsular Malaysia, and Borneo. In Sabah, common on Mt. Kinabalu and scattered in Keningau, Kinabatangan, Penampang, Sipitang, Tambunan, and Tawau districts (e.g., *RSNB 4612*, *SAN 16710*, *SAN 47214*, *SAN 66821*, and *SAN 76811*). In Sarawak, known from G. Murud, Lawas district (e.g., *S 26357*) and Datu Protected Forest, Lundu district (e.g., *S 41914*).

Ecology. Chiefly in primary lower montane or upper montane forests at 900–2000 m altitude but at Datu Protected Forest occur in mixed dipterocarp forest at *c.* 400 m. On mountain slopes or sometimes ridges or beside streams; prefers black, moist soils.

3. **Symplocos borneensis** Brand

(of Borneo)

In Engler, Planzenreich 6 (1901) 56; Merrill *op. cit.* (1921) 486; Masamune *op. cit.* 608; Nooteboom *op. cit.* (1975) 134, *op. cit.* (1977) 242; Anderson *op. cit.* 327; Whitmore, Tantra & Sutisna *op. cit.* 341. **Type:** *Beccari PB 3467*, Borneo, Sarawak (holotype P; isotypes K, L).

Twigs straight, *longitudinally grooved*, *glabrous*. **Leaves** spirally arranged, *glabrous*, drying dark olive-green above, paler below; blade narrowly elliptic, *5–8 × 2–2.5 cm*, base acute, *margin entire*, recurved, apex rounded to slightly acuminate, acumen with a broad, rounded tip; midrib channelled above; lateral veins 6–9 pairs, faintly prominent below, joining into an intramarginal vein; intercostal venation reticulate, obscure below; *petiole 3–4 mm long*. **Inflorescences** lax racemes to 5 cm long, 7– more-flowered; axis minutely, sparsely hairy to glabrous; bracts and bracteoles caducous, glabrous, ciliolate, *c.* 1 mm and

0.5 mm long respectively. **Flowers:** pedicels to 2 mm long; calyx glabrous, lobes ciliolate, *c.* 1 mm long; corolla lobes *c.* 5 mm long; stamens 60–80; disk 5-glandular, shortly pilose; ovary glabrous, 1–1.25 mm high, style *c.* 5 mm long, glabrous except for the conical, shortly pilose base. **Fruits** unknown.

Distribution. Endemic in Borneo. Known only by four collections from Sarawak (*Beccari PB 3467*) and W Kalimantan (*Hallier 2197*, *Teijsmann 8402* and *Teijsmann 8403*).

Ecology. Lowland mixed dipterocarp forest.

4. **Symplocos buxifolia** Stapf

(Latin, *Buxus* = the box tree, *folium* = leaf; with leaves like those of the box tree)

FMK (1894) 206; Brand *op. cit.* (1901) 64; Merrill *op. cit.* (1921) 486; Masamune *op. cit.* 608; Nooteboom *op. cit.* (1975) 136, *op. cit.* (1977) 243; Whitmore, Tantra & Sutisna *op. cit.* 341. **Type:** *Low s.n.*, Borneo, Sabah, Mt. Kinabalu (holotype K; isotypes CGE, LE).

Shrub or small tree to 10 m tall. **Twigs** *straight*, *stout*, to 6 mm diameter, *without prominently raised leaf scars*; young parts longitudinally ridged; *older parts becoming horizontally cracked*, glabrous or almost so, dark brown. **Leaves** spirally arranged, densely set, coriaceous, glabrous on both surfaces, drying olive-brown above, brownish green or yellow-green below; *blade obovate-elliptic*, *2–4.5 × 1–2.5 cm*, base shortly attenuate, decurrent as flanges on petiole, *margin recurved only from midpoint to leaf base*, *plane and sharply black-gland-tipped denticulate from midpoint to apex*, *apex obtuse to rounded*; midrib narrowly channelled above; *lateral veins 4–6 pairs*, raised or impressed above, prominently raised below, looping and joining at some distance from margin; intercostal venation reticulate, raised or obscure above, prominently raised below; petiole *c.* 4(–5) mm long, channelled and sharply flanged to the base, glabrous, eventually rugulose. **Inflorescences** in the axils of upper leaves, 1–3-flowered racemes or flowers solitary; *axis 1.4–3 cm long*, glabrous or with sparse, appressed hairs distally, bearing a few to many subfoliose, elliptic, caducous, glabrous, ciliate-margined bracts to 6 × 2 mm. **Flowers:** pedicels to 4 mm long; calyx divided to base, *lobes* ovate, blunt-tipped, membranous, glabrous, sometimes ciliate at base, 2.5–2.75 mm long; corolla yellow to white when fresh, glabrous, lobes *c.* 5 mm long; stamens numerous; ovary glabrous, 1.5–2 mm high. **Fruits** ellipsoid-ovoid, *c.* 1.3 × 0.6 cm, hardly ridged, *glabrous*, purple when fresh, drying brown, with persistent, more or less erect calyx lobes.

Distribution. Endemic in Sabah. Only known from Mt. Kinabalu area (e.g., *Clemens 51123*, *RSNB 877*, *SAN 22064*, *SAN 29289*, *SAN 46551*, and *SAN 54687*).

Ecology. Montane to subalpine forests at 2600–4100 m altitude.

5. **Symplocos buxifolioides** K.G.Pearce

(resembling *Symplocos buxifolia*)

Gard. Bull. Sing. 55 (2003) 69. **Type:** *Chew & Corner RSNB 5882*, Borneo, Sabah, Mt. Kinabalu, Mesilau (holotype SING).

Tree to 10 m tall, to 10 cm diameter. **Twigs** weakly, irregularly curved, *smaller ones distinctly zigzag with nodes closely set*, slender, up to 4 mm diameter, dark brown to black; young parts longitudinally ridged and sparsely appressed long-pilose; *older parts becoming horizontally cracked*, *glabrescent*, *without prominently raised leaf scars*. **Leaves** spirally arranged; coriaceous, glabrous above, hairy to virtually glabrous below, drying olive-brown above, yellow-green below; *blade broadly ovate-elliptic*, 2.5–4.5 × 1–3 cm, base shortly attenuate, *margin revolute except sometimes at apex*, *shallowly*, *obscurely toothed from near base*, *apex acute*, *shortly apiculate*; midrib narrowly channelled above; *lateral veins* (*6*–)*7*–*8 pairs*, joining to form an intramarginal vein; intercostal venation reticulate, raised above and prominently raised below; petiole 3.5–5 mm long, sharply flanged to base. **Inflorescences** in the axils of upper leaves and below on leafless twigs, 1–3-flowered racemes; *axis 2*–*5*(–*9*) *mm long*, shortly, moderately densely appressed-pilose; bracts early caducous. **Flowers:** pedicels to 0.5 mm long; calyx tube *c.* 0.3 mm long, lobes broadly ovate, chartaceous, ciliate almost to apex, moderately densely to sparsely appressed-hairy, *c.* 1 mm long; corolla white, glabrous, 3.5–4 mm long; ovary sparsely to densely appressed hairy, 1.5 mm high. **Fruits** solitary on a pedicel to 9 mm long, ovoid to curved ellipsoid, 1–1.5 × 0.5–0.7 cm, hardly to shallowly ridged, sparsely appressed-pilose to glabrescent, drying yellowish brown, with persistent and erect calyx lobes.

Distribution. Endemic in Borneo. Only known from Mt. Kinabalu in Sabah (e.g., *Hotta 3840*, *RSNB 5882*, *RSNB 5911*, *SAN 46593*, and *SAN 54254*).

Ecology. Upper montane forest at 2400–3600 m altitude.

6. **Symplocos celastrifolia** Griff. *ex* C.B.Clarke Fig. 2.

(Latin, with leaves like those of *Celastrus*, Celastraceae)

In Hooker *f.*, Fl. Brit. Ind. 3 (1882) 575; Brand *op. cit.* (1901) 48; King & Gamble *op. cit.* 239; Merrill *op. cit.* (1921) 486; Ridley *op. cit.* (1923) 302; Merrill *op. cit.* (1929) 248; Masamune *op. cit.* 608; Nooteboom *op. cit.* (1975) 138, *op. cit.* (1977) 244; Kochummen *op. cit.* 269; Anderson *op. cit.* 328; Whitmore, Tantra & Sutisna *op. cit.* 341; Turner *op. cit.* 479; Coode *et al.* (eds.) *op. cit.* 315; Argent *et al.* (eds.) *op. cit.* 619. **Type:** *Griffith 3651*, Peninsular Malaysia, Malacca (holotype K). **Synonyms:** *Eugeniodes celastrifolius* (Griff. *ex* C.B.Clarke) Kuntze *op. cit.* 975; *Symplocos nigricans* Brand *op. cit.* (1901) 49; *S. candicans* Brand *op. cit.* (1901) 49; *S. hutchinsonii* Brand, Philip. J. Sci. (1909) Bot. 109; *S. peninsularis* Brand *op. cit.* (1909) 110.

Tree to 30 m tall, to 60 cm diameter. **Bark** smooth to scaly and lenticellate, brown or grey; inner bark red to yellow, exuding white sap. **Sapwood** white to yellow, soft. **Twigs** *weakly curved*, terete, to 4(–5) mm diameter, *finely striate*, *glabrous*; young parts typically rich or dark brown; older parts grey-brown, sometimes with conspicuous pale, warty lenticels. **Leaves** spirally arranged, chartaceous to thin-coriaceous, *glabrous or sparsely appressed-pilose on midrib and veins below*, *drying olive-green often with a pattern of fine*, *dark marks parallel to the veins*, *to almost black above*, *usually considerably paler below*; blade elliptic to elliptic-obovate, (2–)6–8(–12) × (0.8–)2.5–4(–6) cm, base attenuate, decurrent on petiole, *margin usually distinctly*, *coarsely crenate with black glandular teeth*, thickened, plane or slightly recurved, *apex shortly acuminate*, *acumen to 1.3 cm long*; midrib above broadly, shallowly impressed at least near leaf base to flat near leaf apex; lateral veins (6–)8–9(–11) pairs, fine, obscure, branching and merging with the reticulations towards margin to form an indistinct intramarginal vein; petiole (3–)5–7(–12) mm long, flat or hardly channelled, flanged to base due to decurrence of lamina, glabrous or occasionally hairy, drying dark. **Inflorescences** in the axils of upper leaves, *many-flowered racemes to 9.5 cm* *long* with up to 2 basal branches; axis slender, shortly appressed-pilose; bracts and bracteoles keeled, caducous or persistent at anthesis, glabrous to rarely shortly, sparsely appressed-pilose especially on the keel, ciliate, to 2 mm long and 1.5 mm long, respectively. **Flowers** sessile or pedicellate (pedicel to 4 mm long); calyx glabrous, tube to 1 mm long, lobes oblong-ovate, blunt, entire to minutely ciliate, drying pale, to 1.5 mm long; corolla oblong-obovate, white and fragrant when fresh, glabrous, to 4 mm long; stamens 25 to numerous; disk glabrous; ovary glabrous, drying darker than calyx, to 1 mm high, style glabrous. **Fruits** *ovoid to almost globose*, *c.* 1 × 0.7(–0.9) cm, smooth, ripening deep bluish-purple, drying warm-brown, glabrous, with conspicuous, erect and apically incurved to slightly spreading calyx lobes.

Vernacular names. Sabah—*dampol*, *enadak* (Dusun), *inderatan* (Bajau), *inderopis*, *kalasiwai* (Dusun), *kulim babok* (Malay), *lamai-lamai* (Dusun), *makulat*, *mata kinai*, *rinda-rinda*, *tukil-tukil* (Dusun). Sarawak—*jirak*, *maba* (Iban), *puruk*, *purup* (Dayak).

Distribution. Peninsular Thailand and throughout Malesia except Java, the Lesser Sunda Is., the northern islands of the Philippines, the northern half of Sulawesi, and most parts of Maluku. In Borneo, common in Sabah and frequently collected in most districts (e.g., *SAN 98754*, *SAN 102576*, *SAN 127398*, *SAN 133557*, and *SAN A 4090*). In Sarawak, less common and known from Bintulu, Kuching, Lundu, Mukah, and Saratok districts (e.g., *S 8437*, *S 12023*, *S 18498*, *S 24530*, and *S 31589*). Also recorded from Brunei (e.g., *BRUN 693*, *BRUN 5361*, *BRUN 7829*, *BRUN 7859*, and *Wong WKM 198*) and from Kalimantan (e.g., *Kostermans 6108*).

Ecology. Most common at or near sea level, on rocks by the sea or at the inland margin of sandy beaches, also in swamp forests and at the edge of mangrove forest, on flat or hilly land and often by rivers and on sandy soils. In Sabah, once collected at 1000 m altitude.

Uses. The timber is used for firewood.

7. **Symplocos cerasifolia** Wall. *ex* A.DC.

(Latin, *cerasus* = the cherry tree, *folium* = leaf; with leaves like those of cherry tree)

Prodr. 8 (1844) 257; Miquel, Fl. Ned. Ind. 1, 2 (1859) 466; C.B. Clarke *op. cit.* 580; Brand *op. cit.* (1901) 52; King & Gamble *op. cit.* 245; Ridley *op. cit.* (1923) 306; Nooteboom *op. cit.* (1975) 140, *op. cit.* (1977) 245; Kochummen *op. cit.* 269; Anderson *op. cit.* 328; Whitmore, Tantra & Sutisna *op. cit.* 341; Turner *op. cit.* 479; Argent *et al.* (eds.) *op. cit.* 619. **Type:** *Wallich 4434*, Peninsular Malaysia, Penang (holotype G-DC; isotypes BM, CGE, K-W, LE). **Synonyms:** *Bobua cerasifolia* (Wall. *ex* A.DC.) Miers, J. Linn. Soc. Bot. 17 (1879) 304; *Eugeniodes cerasifolia* (Wall. *ex* A.DC.) Kuntze *op. cit.* 975.

Tree to 20 m tall, to 21 cm diameter. **Bark** smooth, grey to brown; inner bark fibrous, red to brown, exuding some watery sap. **Sapwood** white to yellow. **Twigs** *fairly straight*, *glabrous or with scattered weak hairs to more than 2 mm long*, minutely striate and shallowly grooved and red-brown near apex; *older parts* terete, *coarsely striate*, grey. **Terminal buds** with ovate to orbicular, dark, ciliate, sparsely to densely appressed long-pilose, keeled scales to 7 mm long. **Leaves** spirally arranged, chartaceous to thin-coriaceous, *with a few scattered*

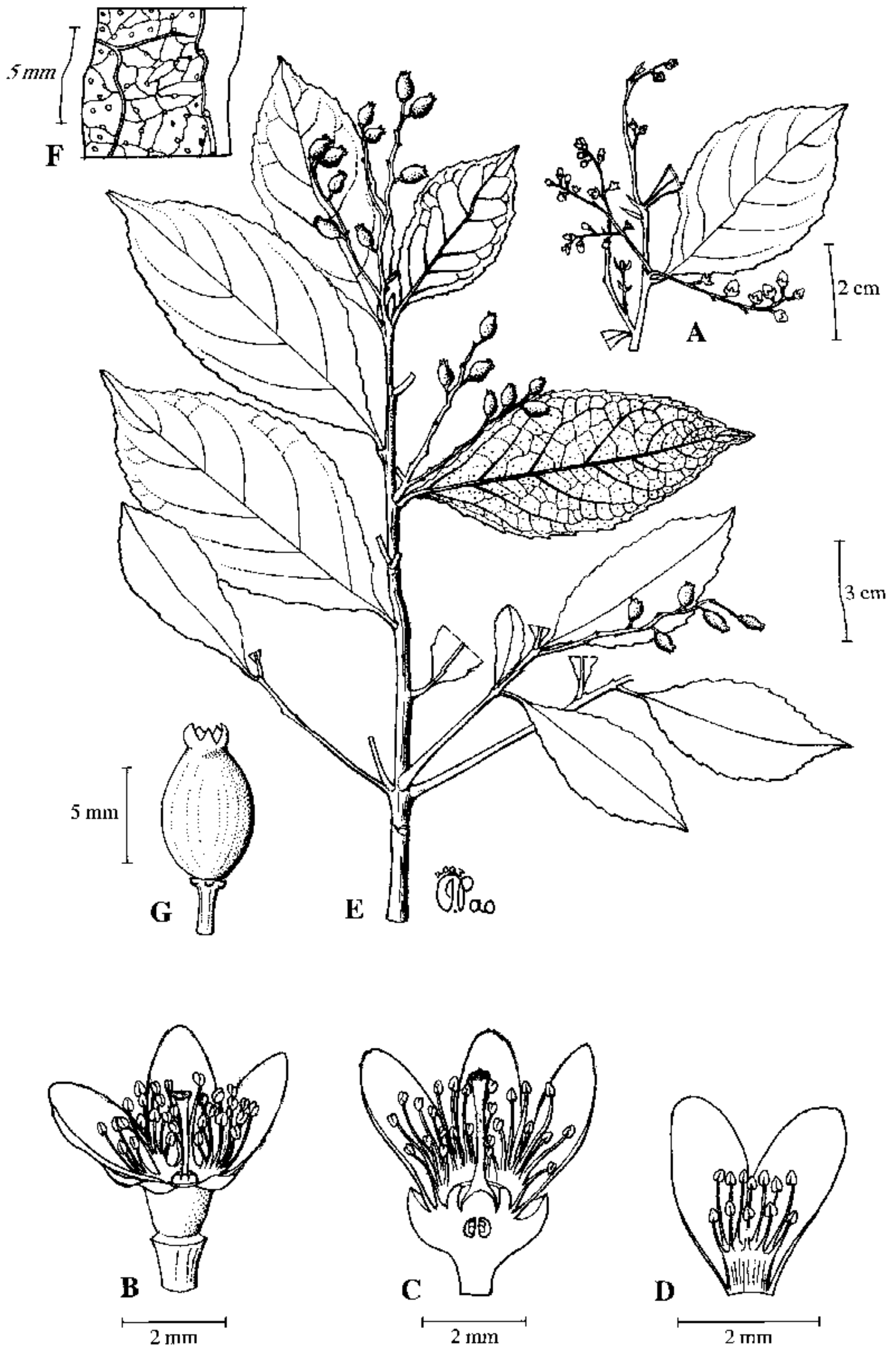

Fig. 2. *Symplocos celastrifolia.* A, flowering leafy twig; B, fully open flower with two petals removed; C, longitudinal section of open flower; D, adaxial view of stamen-bundle; E, fruiting leafy twig; F, detail of venation of lower leaf surface near margin; G, fruit. (A–D from *SAN A 2120*, E–G from *SAN 84353*.)

hairs to virtually glabrous except on midrib and veins below, *drying olive-grey to olive-brown*; blade elliptic to elliptic-obovate, (8–)11–17(–22) × (2.5–)3–6 cm, base narrowly to broadly cuneate-attenuate, *margin plane*, *bluntly black-glandular-tipped serrate*, *often with 1 to several shallower teeth between longer ones*, *apex acuminate*, *acumen 0.7–2.2 cm long*; *midrib finely channelled above*, *sparsely long-pilose to virtually glabrous below*, warm-brown below; *lateral veins* 9–12 pairs, *more or less sunken above*, *looping and joining to form an indistinct intramarginal vein*; *intercostal venation fine*, *irregularly*, *distantly*, *wavy-scalariform*; *petiole 10–22 mm long*, *scarcely channelled*, *flanged near leaf blade or to base*, glabrous or pilose as twig, drying same colour as twig. **Inflorescences** in the axils of upper leaves, *10*(*–15*)*-flowered spikes to 3.2 cm long*, in bud spherical or resembling a short cone due to overlapping bracts; axis densely rufous-tomentose; *bracts* orbicular, rounded to emarginate, *caducous*, ciliate, outermost ones almost glabrous, inner ones densely pale or rufous appressed-tomentose except on margins, to 6 mm long; bracteoles oblong, ciliate, tomentose, keeled, caducous or occasionally persistent at anthesis, *c.* 3.5 mm long. **Flowers** sessile; calyx glabrous, green when fresh, to 3.5 mm long, lobes triangular, 1–1.2 mm long; corolla lobes oblong-elliptic, white when fresh, glabrous, to 4 mm long; stamens 50 or more, yellow when fresh; disk minutely hairy; ovary drying rich brown in contrast with paler calyx, glabrous, 0.7–1.5 mm high, style glabrous. **Fruits** solitary or two per infructescence, *ellipsoid-ovoid*, *occasionally ellipsoid-obovoid*, *3.5*(*–4*) × *2 cm*, glabrous, not or faintly ridged, white to green to bluish green; *calyx lobes or their remains inclined over the deeply sunken style-base*.

Vernacular names. Sabah—*madang* (Malay). Sarawak—*jirak* (Iban).

Distribution. Extreme southern parts of Peninsular Thailand, Sumatra (including Bangka), Peninsular Malaysia, Borneo, and W New Guinea. In Sabah, known from Kinabatangan, Lamag, Ranau, Sandakan, Sipitang, and Telupid districts (e.g., *SAN 45168*, *SAN 72919* and *SAN 79081*). In Sarawak, recorded from Kapit, Kuching, Lundu, and Simunjan districts (e.g., *S 36158*, *S 38599*, *S 41599*, *S 41966*, and *S 68486*). Also occurring in Kalimantan (e.g., *Veldkamp 8519*).

Ecology. Chiefly in lowland mixed dipterocarp forest but also in *kerangas*, hill mixed dipterocarp and lower montane forests to 1000 m altitude, on hillsides and ridges.

Notes. Nooteboom (*op. cit.* (1975) 140) distinguished two varieties, *viz*. var. *cerasifolia* and var. *grandifolia* Noot. In Sabah and Sarawak, only var. *cerasifolia* has been recorded. Var. *grandifolia* is apparently rare and known only from Asahan in Sumatra.

8. **Symplocos cochinchinensis** (Lour.) S.Moore

(of Cochin-china)

J. Bot. 52 (1914) 148; Nooteboom *op. cit.* (1975) 141, *op. cit.* (1977) 245; Kochummen *op. cit.* 269; Anderson *op. cit.* 328; Whitmore, Tantra & Sutisna *op. cit.* 341; Turner *op. cit.* 480; Argent *et al.* (eds.) *op. cit.* 619. **Basionym:** *Dicalyx cochinchinensis* Lour., Fl. Cochinch. 1 (1790) 663. **Type:** *Loureiro s.n.*, "Cochinchina" (holotype BM). **Synonyms:** *Symplocos ferruginea* Roxb., Fl. Ind. ed. Carey 2 (1832) 542; *S. spicata* Roxb., *op. cit.* 542; *S. laurina* Wall. *ex* G.Don *op. cit.* 3; *S. mollis* Wall. *ex* G.Don *op. cit.* 3; *S. spicata* Roxb. var. *malasica* C.B.Clarke *op. cit.* 573.

Tree to 35 m tall, to 50 cm diameter. **Bark** smooth, black, grey, brown or sometimes green; inner bark orange to yellowish green. **Sapwood** white to yellow, medium hard. **Twigs** *straight to obscurely zigzag*, *terete*, *coarsely striate*; *younger parts densely shortly rufous* *tomentose to almost glabrous*, pale to dark brown; *older parts glabrescent*, *grey to brown*, sometimes with peeling bark. **Terminal buds** with pale to rufous indumentum. **Leaves** spirally arranged, chartaceous to coriaceous, *with scattered hairs to virtually glabrous above and similar to more densely hairy below*, *drying olive-yellow*, *olive-green or olive-brown*; blade elliptic to ovate-elliptic or obovate-elliptic to oblong, 6–18(–20) × 2–8(–9) cm, *base cuneate to obtuse*, *hardly decurrent on petiole*, *margin faintly to distinctly toothed*, *apex short-acuminate*; *midrib channelled above at least near leaf base*, glabrous to tomentose; *lateral veins* 6–14 pairs, *inconspicuous above*, prominently raised below, *not forming a distinct intramarginal vein*; *intercostal venation reticulate*, inconspicuous above, distinct below; *petiole 6–20 mm long*, *channelled at least distally*, tomentose as twig to glabrescent. **Inflorescences** in the axils of upper leaves, *spikes or racemes bearing numerous flowers*, *to 9.5 cm long*, *with up to 3 basal branches*; *bracts and bracteoles* 1–2 mm or longer, *together forming a calicyle hiding the ovary or enveloping the base of the ovary*, *persistent after anthesis*. **Flowers:** calyx appressedly pubescent to glabrous. **Fruits** *flask-shaped to globose*, *0.5–1 × 0.4–0.8 cm*; calyx enlarged and forming a conical beak or not.

Vernacular names. Sabah—*kayu ara* (Kota Belud). Sarawak—*jirak* (Iban, Belaga), *kayu buyun* (Kelabit).

Distribution. India, Myanmar, Thailand, Indo-China, China (including Hainan), Japan, Ryu Kyu Is., Taiwan, throughout Malesia (except the Lesser Sunda Is., Sulawesi and Maluku) to Australia, the Solomons, New Hebrides and Fiji. In Borneo, recorded from Brunei, Kalimantan, Sabah, and Sarawak.

Ecology. In primary and secondary mixed dipterocarp to lower montane forests to 1800 m altitude but most commonly above 1300 m, on hillslopes and ridges and sometimes by streams, on brown soils.

Uses. In Sarawak, Kelabit women wear the seeds as beads, as protection against evil spirits after childbirth.

Notes. Nooteboom (*op. cit.* (1975) 141) recognised four subspecies, *viz.* subsp. *cochinchinensis*, subsp. *laurina*, subsp. *leptophylla*, and subsp. *thwaitesii*, of which only subsp. *cochinchinensis* and subsp. *laurina* occur in Sabah and Sarawak.

Key to subspecies and varieties

Leaves with 10–14 pairs of lateral veins. Calyx lobes more or less densely hairy, often enlarged in fruit, forming a conical beak………………..……………………………………

subsp. **cochinchinensis** var. **cochinchinensis**

Nooteboom *op. cit.* (1975) 150, *op. cit.* (1977) 246. Synonyms: *Symplocos ferruginea* Roxb., *op. cit.* 542; *S. mollis* Wall. *ex* G.Don *op. cit.* 3.

Twigs with young parts densely, *shortly rufous tomentose*. Leaves (6.5–)8–18(–20) × (2–)8(–9.4) cm, *margin slightly recurved*, *distinctly*, *sharply dark-glandular toothed*, apex sharp. Inflorescences spikes with up to 3 basal branches; axis indumentum similar to or denser than that of twig; bracts *c.* 2 mm long, *bracts and bracteoles spreading and overlapping to form a shallow cup* (*persistent in fruit*) *round the short*, *glabrous to sparsely pilose*, *rugulose ovary which is thus entirely concealed at anthesis*. Fruit flask-shaped to almost globose, to 0.9 × 0.8 cm, slightly rugulose or ribbed, drying dark brown to black, including the conical beak formed by the overlapping calyx lobes.

Distribution as for the species but not reaching Australia, the Solomons, New Hebrides and Fiji and scarce in the Philippines. In Sabah, recorded from Keningau, Kota Belud and Ranau districts (e.g., *SAN 29246*, *SAN 32350*, *SAN 32391*, *SAN 53958*, *SAN 76410*, and *SAN 87417*) and in Sarawak, from Marudi and Sri Aman districts (e.g., *S 42709*, *S 51083*, *S 51536*, and *S 51578*). Also known from C Kalimantan (e.g., *bb 13698* and *Hallier 1379*).

Leaves with 6–9 pairs of lateral veins. Calyx lobes, if hairy, then sparsely so, not enlarged in fruit……………………………………………………………………………………………

subsp. **laurina** (Retz.) Noot. var. **laurina**

(Latin, *Laurus* = a bay tree; like the bay tree)

Nooteboom, Leiden Bot. Ser. 1 (1975) 156, *op. cit.* (1977) 248; Kochummen *op. cit.* 269. Basionym: *Myrtus laurinus* Retz., Observ. Bot. 4 (1786) 26. Type: *Herbarium Hermann*, Sri Lanka (holotype P, *n.v.*; isotype L). Synonyms: *Symplocos spicata* Roxb., *op. cit.* 542; *S. laurina* Wall. *ex* G.Don *op. cit.* 3; *S. spicata* Roxb. var. *malasica* C.B.Clarke *op. cit.* 573.

Twigs with young parts almost glabrous with a few long weak hairs. Leaves 6–11 × 2.5–4 cm; *margin plane*, *hardly to bluntly toothed*, *acumen apically rounded*. Inflorescences racemes, sometimes with a basal branch; axis minutely tomentose to glabrescent; bracts *c.* 1 mm long, mostly not persisting to fruiting stage. Fruits ovoid to almost globose, 0.6–0.8 × 0.8–1 cm, smooth, drying medium brown, with triangular, *apically rounded calyx lobes not enlarged in fruit but inclined towards the remains of the style base or even flattened onto the apex of the fruit*.

India, Sri Lanka, Myanmar, Thailand, Indo-China, China (including Hainan), Taiwan, Japan, Sumatra, Peninsular Malaysia, Borneo, Java, and Sulawesi. In Sabah, known only from Ranau district (e.g., *SAN 123332*) in hill ridge forest. In Sarawak also rare, recorded only from Belaga district at 500 m (e.g., *S 67907*). Also occurring in Brunei (e.g., *Coode 7936*) and Kalimantan (e.g., *Jaheri 1758* and *Main 2121*).

9. **Symplocos colombonensis** Noot.

(of the Kolombon R. basin, Sabah)

Leiden Bot. Ser. 1 (1975) 177, *op. cit.* (1977) 255; Whitmore, Tantra & Sutisna *op. cit.* 342. **Type:** *Clemens 33706*, Borneo, Sabah, Mt. Kinabalu, Kolombon R. basin (holotype L; isotypes BM, BO, G, K).

Shrub or treelet to 10 m tall. **Twigs** *somewhat zigzag*, *dark brown appressed-tomentose*. **Leaves** alternately arranged, glabrous above, *sparsely appressed-pilose below especially on the margin*; *blade ovate*, 4–9 × 1.5–3.5 cm, base cuneate to rounded, often shortly attenuate, *margin often revolute*, *often sharply glandular-dentate*, *apex acuminate*, *acumen* (*0.7–*)*0.9–1.6 cm long*; *midrib channelled above*, prominent below, appressed-pubescent; *lateral veins* 7–11 pairs, *arching upwards and joining with the reticulations towards the margin or into an inconspicuous intramarginal vein*; *intercostal venation prominent*, *rather coarsely reticulate*; *petiole 3–4 mm long*, *not swollen along its length*, indumentum as that of twig. **Inflorescences** *lax*, *3-flowered racemes to 3 cm long*; *bracts and bracteoles soon caducous*, pubescent. **Flowers:** *pedicel* finely appressedly pubescent, *1–5 mm long*; *calyx appressedly brown pilose*, tube 2–3 mm long, lobes triangular, 1.5–2.5 mm long; corolla glabrous or thinly red-hairy on the outside in bud, *c.* 5 mm long; stamens *c.* 90 or more arranged in 5 distinct bundles, up to 7 mm long; disk glabrous or with some hairs, 5-glandular; ovary appressedly brown-pilose, 1.5–2 mm high, style glabrous, thickened towards the base, 4–5 mm long. **Fruits** *ovoid or ellipsoid*, *1–1.5 × 0.6 mm*, with persistent calyx lobes.

Distribution. Endemic in Borneo and confined to the western slopes of Mt. Kinabalu in Sabah (e.g., *Clemens 33766*, *Clemens 51103*, *Nooteboom 1496*, and *SFN 27507*).

Ecology. Upper montane forest at 2100–3100 m altitude.

10. **Symplocos costatifructa** Noot. Fig. 3.

(Latin, *costatus* = ribbed, *fructus* = fruit; the ribbed fruit)

Blumea 31 (1986) 277, FM 1, 10 (1989) 719; Whitmore, Tantra & Sutisna *op. cit.* 342; Coode *et al.* (eds.) *op. cit.* 315. **Type:** *Chai S 34756*, Borneo, Sarawak, Baram district, Ulu Tinjar (holotype L; isotypes K, KEP, SAR).

Treelet to 10 m tall, to 10 cm diameter. **Bark** smooth, hoop-marked, brown; inner bark white to pale brown, thin. **Sapwood** white or red-yellow. **Twigs** *more or less curved*, more than 4 mm diameter; *young parts grooved*, *drying pale yellowish-green*; *older parts terete*, *striate*, *virtually glabrous*, *dark brown.* **Terminal buds** *prominent*, *lanceolate*, *appressed-pilose*, drying brown. **Leaves** spirally arranged, *mostly located at or near apex of twig*, coriaceous, *slightly glossy at least above*, *both surfaces glabrous*, *drying pale*, *yellow-green or buff-green*; blade oblong-elliptic to obovate, 11–28(–35) × 4–8(–10) cm, *base shortly attenuate*, *slightly decurrent on petiole*, *margin recurved*, *obscurely toothed*, *apex acuminate*, *acumen to 2 cm long*; *midrib and veins sunken above*; *lateral veins* 9–12 pairs, *joining to form an intramarginal vein 6–12 mm from margin at its furthest point*; *intercostal venation reticulate*, *distinct*, *raised on both surfaces*; *petiole 12–16 mm long*, *shallowly channelled and shortly winged*, glabrous, smooth, drying yellow-green. **Inflorescences** axillary, erect, *simple or basally branched up to 10-flowered spikes*, *1.5–2.5 cm long*; axis appressedly to obliquely short-pilose; *bracts lanceolate-ovate*, *caducous*, leaving prominent crescent-shaped scars, appressedly long-pilose, to 5.5 × 1.5 mm; *bracteoles triangular*, *caducous*, to 0.3 × 0.6 mm. **Flowers:** calyx glabrous, tube to 0.3 mm long, lobes broadly triangular, *c.* 0.5 mm long; corolla white when fresh, glabrous, tube to 0.75 mm long, lobes 5–6 × 2.5 mm; stamens *c.* 35, cream when fresh; disk glabrous; ovary glabrous, *c.* 1.5 mm high, *c.* 1 mm diameter, stigma yellow when fresh. **Infructescences** to 4.5 cm long, *bearing 1–2 fruits*. **Fruits** *ovoid*, *c. 3 × 1.5 cm*, ribbed, glabrous, white or cream.

Distribution. Endemic in Borneo. Rare in Sabah and known only from Keningau, Ranau and Sipitang districts (e.g., *SAN 72131*). In Sarawak, recorded from Belaga and Miri district (e.g., *S 39987*, *S 48183*, *S 48232*, and *S 80610*). Also occurring in Belait and Temburong districts, Brunei (e.g., *BRUN 216* and *Dransfield JD 7464*).

Ecology. In mixed dipterocarp and primary *kerangas* forests at 50–1300 m altitude, often on river-banks, gentle slopes and hills, on sandy, pebbly or rocky soils.

11. **Symplocos crassipes** C.B.Clarke

(Latin, *crassus* = thick, *pes* = foot; alluding to the thick stem)

In Hooker *f.*, Fl. Brit. Ind. 3 (1882) 580; Brand *op. cit.* (1901) 52: King & Gamble *op. cit.* 245; Ridley *op. cit.* (1923) 305; Nooteboom *op. cit.* (1975) 180, *op. cit.* (1977) 256; Kochummen *op. cit.* 269; Anderson *op. cit.* 328; Whitmore, Tantra & Sutisna *op. cit.* 432; Turner *op. cit.* 480; Coode *et al.* (eds.) *op. cit.* 315. **Type:** *Maingay 2597* (= *Kew Distr. 960*), Peninsular Malaysia, Malacca, Mt. Ophir (holotype K). **Synonyms:** *Symplocos curtisii* Oliv. *in* Hooker, Icon. Pl. Ser. 3, 18 (1888) *t.* 1757; *S. havilandii* Brand *op. cit.* (1901) 41; *S. ernae* Brand *op. cit.* (1901) 58; *S. monticola* King & Gamble *op. cit.* 235; *S. brandiana* King & Gamble *op. cit.* 242; *S. penangiana* King & Gamble *op. cit.* 245.

Shrub or tree to 15(–23) m tall, to 50 cm diameter. **Bark** smooth, brown to dark brown or grey; inner bark pale yellow to brown, thin, hard. **Sapwood** pale yellow to orange; heartwood medium hard. **Twigs** *straight to obscurely zigzag*, terete, *variously pubescent or pilose to glabrescent*, medium to dark brown or grey; young parts striate; *older parts almost smooth*. **Leaves** spirally arranged, chartaceous, virtually glabrous above, *glabrous to variously pilose below*; blade elliptic to ovate, 2–19 × 1–7.5 cm, base attenuate, cuneate, obtuse or rounded, *margin plane to recurved*, *obscurely to sharply toothed*, *apex acuminate with acumen to 2.2 cm long*; *midrib channelled above*, sparsely to densely hairy below; *lateral veins* 3–11 pairs, *ascending and curving for most of their length*, *joining to form an intramarginal vein or not*; *petiole* 2–12 mm long, *not swollen along its length*. **Inflorescences** contracted, to 10-flowered, *to 1.5 cm long*, or flowers sessile in the leaf axils; axis, where present, variously hairy; *bracts broadly ovate or elliptic to semi-orbicular*, *hairy*, persistent at anthesis. **Flowers:** calyx lobes hairy; ovary variously hairy. **Infructescences** *mostly with 1–2 fruits*. **Fruits** *ovoid*, *ellipsoid*, *obovoid or cylindrical-ovoid*, *to 1.5 × 0.8 cm*, somewhat curved, somewhat ridged, ripening pale or dark blue, *with erect to incurved calyx lobes forming a beak.*

Vernacular name. Sarawak—*jirak* (Iban).

Distribution. Peninsular Thailand, Peninsular Malaysia and Borneo.

Ecology. Most common in primary mixed dipterocarp forest, but also in *kerangas*, secondary, hill and lower montane forests, at altitude to 1500 m, on undulating lands, hillslopes and summits and sometimes near streams, on sandy, sandy clay and ultrabasic soils.

Notes. Nooteboom (*op. cit.* (1975) 180) recognised seven different varieties in this species. Of these, four varieties, *viz.* var. *ernae*, var. *havilandii*, var. *penangiana*, and var. *rufomarginata* occur in Sabah and Sarawak.

Key to varieties

1. Leaves to 4.8(–6) cm long, base rounded; lateral veins 3–6 pairs. Flowers solitary……..
   var. **havilandii** (Brand) Noot.
   (J.D. Haviland, 1857–1901, First Sarawak Medical Officer, plant and insect collector)
   Leiden Bot. Ser. 1 (1975) 184, *op. cit.* (1977) 258. Basionym: *Symplocos havilandii* Brand *op. cit.* (1906) 41. Type: *Haviland s.n.*, Borneo, Sarawak, Matang (holotype K; isotype BO).
   Treelet to 8 m tall. *Leaves* drying yellow-green; *blade broadly ovate*, *3–5(–6) × 1–3 cm*, *apex long-acuminate with acumen to 1.6 cm long*; petiole 2–3.5 mm long. *Fruits with densely rufous tomentose*, *more or less erect calyx lobes*.
   Endemic in Sarawak, only known from Mt. Matang and G. Serapi, Kuching district (e.g., *Haviland 632/247*, *Ridley 12297* and *S 17783*). In hill and lower montane forests at 600–1400 m altitude.

   At least some leaves 5.5 cm long or longer, base attenuate, cuneate, obtuse or, if rounded, then leaves usually at least 6 cm long. Flowers otherwise……………...............………2

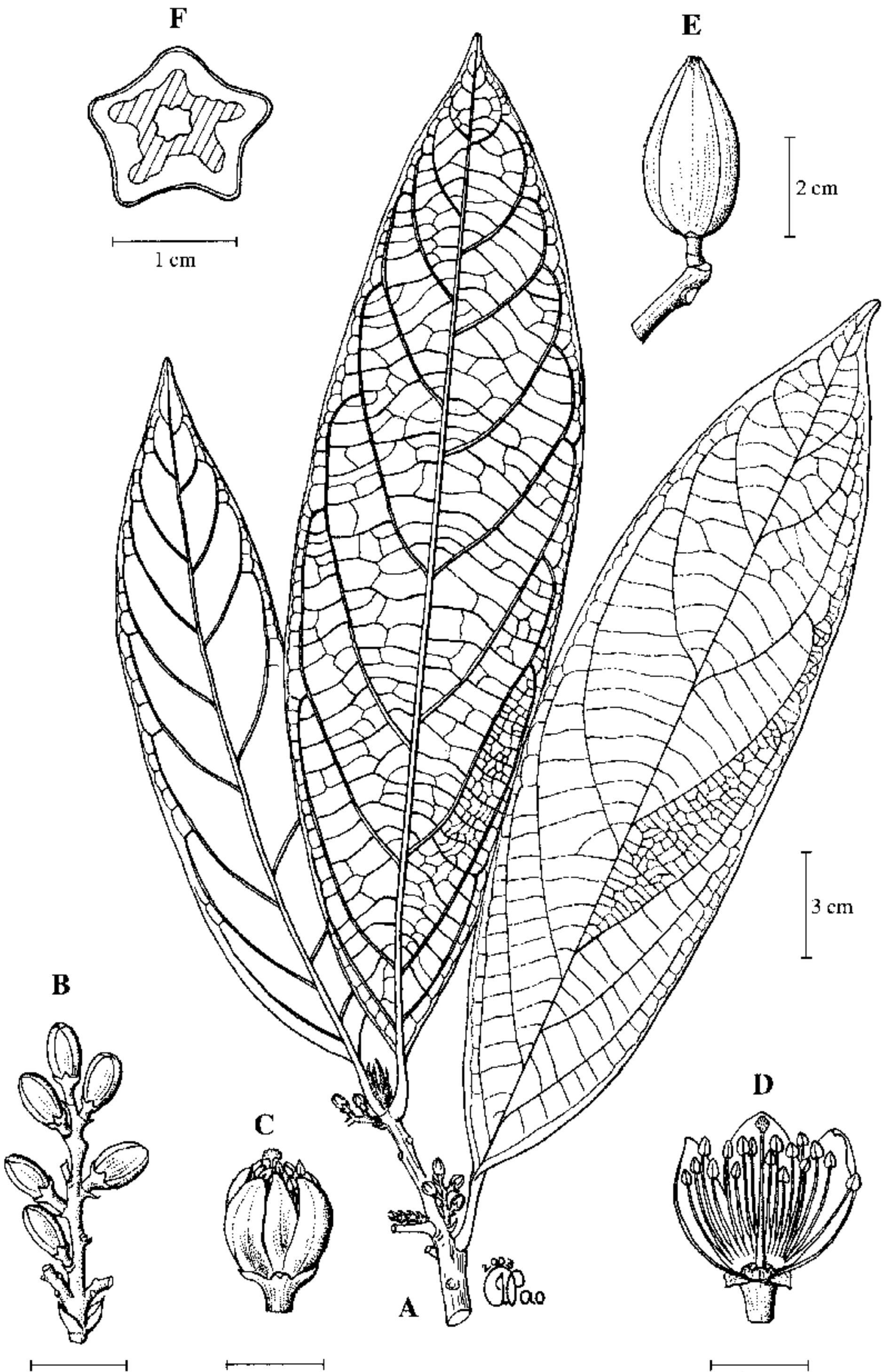

Fig. 3. *Symplocos costatifructa.* A, flowering (young) leafy twig; B, young inflorescence; C, opening flower; D, longitudinal section of opening flower; E, fruit; F, cross-section of fruit. (A–D from *S 39987*, E–F from *S 34756*.)

2. Leaves and veins glabrous to sparsely appressed-pilose below, drying warm brown……

   var. **ernae** (Brand) Noot.

   (derivation unknown)

   Leiden Bot. Ser. 1 (1975) 184, *op. cit.* (1977) 258; Kochummen *op. cit.* 270; Turner *op. cit.* 480; Coode *et al.* (eds.) *op. cit.* 315. Basionym: *Symplocos ernae* Brand *op. cit.* (1901) 58. Lectotype (Nooteboom, 1975): *Beccari PB 3499*, Borneo, Sarawak, Kuching (hololectotype K; isolectotypes FI, G, P).

   Tree to 23 m tall, to 50 cm diameter. *Leaf always drying distinctly warm brown*; blade elliptic to ovate-elliptic, 3.5–13.5(–18) × 1.5–5(–7.5) cm, apex acuminate, acumen to 2 cm long; lateral veins 4–6(–8) pairs; petiole 3–12 mm long. Fruits obovoid, ovoid or ellipsoid, *c.* 1.5 × 0.8 cm, more or less curved, obscurely ridged, with erect or incurved calyx lobes together forming a curved beak.

   Peninsular Malaysia and Borneo. By far the most widespread variety in Sabah (e.g., *SAN 83805*, *SAN 119673*, *SAN 126641*, *SAN 130121*, and *SAN 135913*) and Sarawak (e.g., *S 13621*, *S 18859*, *S 26920*, *S 32893*, *S 46057*, and *S 52405*). Also known from Brunei (e.g., *BRUN 359* and *Simpson 2251*) and from C and E Kalimantan (e.g., *Endert 2580*, *Endert 3629*, *Kessler et al. 2499*, and *Sidiyasa & Arifin 1979*).

   Leaves and veins moderately to densely appressed-hairy below, drying buff or greenish-buff below……………………………………………………………………3

3. Twigs conspicuously, patently to obliquely brown hairy, hairs at least 1 mm long. Leaves drying buff to grey-buff below; lateral veins 6–11 pairs; intercostal venation prominent……………………………………………………………………………………

   var. **penangiana** (King & Gamble) Noot.

   (of Penang, Peninsular Malaysia)

   Leiden Bot. Ser. 1 (1975) 185, *op. cit.* (1977) 258; Kochummen *op. cit.* 270; Turner *op. cit.* 480. Basionym: *Symplocos penangiana* King & Gamble *op. cit.* 245. Type: *Curtis 325*, Peninsular Malaysia, Penang, West Hill (holotype SING).

   Tree to 3 m tall. Twigs with very short pale pubescence as well as spreading rufous hairs to 5 mm long. Leaves (4.5–)6–19 × (2–)2.5–7 cm, base obtuse to rounded, margin sharply toothed, acumen to 2.2 cm long; *midrib and veins appressedly to obliquely long hairy below.*

   Peninsular Malaysia and Borneo. In Sarawak, known from Tatau and Kapit districts (e.g., *S 40609*).

   Twigs inconspicuously appressed-pubescent. Leaves drying distinctive pale buff-green below; lateral veins 4–6 pairs; intercostal venation fine, obscure……………...………..

   var. **rufomarginata** Noot.

   (Latin, *rufus* = red or red haired, *margo* = a border; the rufous-hairy leaf margin)

   Leiden Bot. Ser. 1 (1975) 185, *op. cit.* (1977) 258. Type: *Haviland 2314*, Borneo, Sarawak, Kuching (holotype K; isotype BO).

   Shrub or small tree to 3.7 m tall. Twigs densely pubescent. Leaves (1.7–)4–10 × (0.9–)1.5–3.5 cm, *margin recurved*, *appressedly rufous hairy*, acumen to 2 cm long. Fruits almost sessile, long-ovoid with a narrow neck.

   Endemic in Sarawak. Known from Kapit and Kuching districts (e.g., *S 13417*, *S 27059*, *S 36064*, *S 36971*, and *S 56090*). In primary mixed dipterocarp forest at 100–500 m altitude.

12. **Symplocos deflexa** Stapf

(Latin, *deflexus* = bend or turn downwards, droop; the infructescence axis)

FMK (1894) 205; Brand *op. cit.* (1906) 64; Gibbs, J. Linn. Soc. Bot. 42 (1914) 109; Merrill *op. cit.* (1921) 487; Masamune *op. cit.* 608; Nooteboom *op. cit.* (1975) 188, *op. cit.* (1977) 258. **Type:** *Haviland 1105*, Borneo, Sabah, Mt. Kinabalu (holotype K; isotype SING).

Treelet to 6 m tall, *8 cm diameter*. **Twigs** *faintly zigzag*, to *c.* 3 mm diameter, *young parts apparently terete*, *striations*, *if any*, *obscured by a dense indumentum of oblique*, *rufous*, *pilose hairs from 0.2 to more than 1 mm long at a single point*; older parts terete, glabrescent, dark brown. **Leaves** *spirally arranged*, chartaceous, virtually glabrous above, densely finely appressed to oblique pale pilose below, *drying olive-brown above*, *paler green to olive-green below*; *blade elliptic*, *2–5 × 1–2.5 cm*, base rounded to obtuse, *margin finely*, *sharply brown-gland-tipped toothed*, recurved to revolute, densely appressedly long-pilose, *apex shortly* (*to 8 mm long*) *acuminate*; *midrib finely channelled above*, with some indumentum at base, densely pilose as twig below; *lateral veins* 5–8 pairs, *merging into reticulations at margin*, *obscure above*, *distinct below*; *petiole to 3 mm long*, *shallowly channelled above*, pilose as twig. **Inflorescences** *lax*, *up to 6-flowered racemes 1–4 cm long*, *with or without a basal branch*, all parts except corolla, stamens, disk and style densely appressedly to obliquely pale rufous pilose; *bracts and bracteoles persistent*, *c.* 5 × 3 and *c.* 3 × 1.5 mm respectively. **Flowers** fragrant; pedicels 2–4 mm long; calyx divided into obtuse and semi-elliptic to acute and triangular lobes *c.* 1.5 mm long; petals glabrous or outer ones minutely appressedly hairy, 4–7 mm long; stamens 60–90; disk low, 5-glandular, sparsely long-pilose; ovary 1.5–2 mm high, style gradually thickened towards base, sparsely long-pilose below, *c.* 5 mm long. **Infructescence** *axis turning downwards*. **Fruits** rather few, *ovoid-ellipsoid*, *to 1 × 0.5 cm*, slightly curved, obscurely ridged, sparsely appressed-pilose, drying pale, with persistent, erect, calyx lobes more densely pilose than the fruit.

Distribution. Endemic in Borneo; known only from the type locality near Paka Cave, Mt. Kinabalu, Kota Belud district in Sabah (e.g., *Clemens 28998*, *Nooteboom 1489*, *SAN 46552*, and *SAN A 4481*).

Ecology. In low subalpine forest and mountain scrubs at 2400–3200 m altitude.

13. **Symplocos fasciculata** (Kuntze) Zoll.

(Latin, *fasciculatus* = bundled; the inflorescence is a bundle of branched racemes)

Syst. Verz. (1854) 136; C.B.Clarke *op. cit.* 574; Koorders & Valeton, Bijdr. Booms. Ned. Ind. 7 (1900) 150 (inclusive var. *blumeana* Koord. & Valeton *op. cit.* 151); Brand *op. cit.* (1901) 34; King & Gamble *op. cit.* 235; Koorders, Atlas 2 (1914) *t.* 383; Merrill *op. cit.* (1921) 487, *op. cit.* (1929) 248; Ridley *op. cit.* (1923) 301; Masamune *op. cit.* 609; Backer & Bakhuizen *f. op. cit.* 205; Nooteboom *op. cit.* (1975) 191, *op. cit.* (1977) 259; Kochummen *op. cit.* 270; Anderson *op. cit.* 328; Whitmore, Tantra & Sutisna *op. cit.* 342; Turner *op. cit.* 480; Coode *et al.* (eds.) *op. cit.* 315; Argent *et al.* (eds.) *op. cit.* 621. **Basionym:** *Eugeniodes fasciculatum* Kuntze *op. cit.* 409. **Lectotype** (Nooteboom, 1975)**:** *Blume 2154*, Java (hololectotype L). **Synonyms:** *Dicalyx tinctorius* Blume, Bijdr. Fl. Ned. Ind. (1826) 1116; *Symplocos fasciculata* (Kuntze) Zoll. var. *genuina* Koord. & Valeton *op. cit.* 151.

Tree to 23(–35) m tall, to 45 cm diameter. **Bark** smooth, pale to dark grey or brown, sometimes greenish; inner bark white, pale yellow or green. **Sapwood** white or pale yellow. **Twigs** *faintly zigzag*, slender to stout; *young parts finely striate to distinctly grooved*, *pubescent*, *pilose to glabrescent*, drying pale or medium-brown to greenish buff; *older parts* terete, *almost smooth*, glabrescent, pale to dark brown. **Leaves** alternately to spirally arranged, chartaceous, *sparsely hairy to glabrescent above*, *densely to sparsely appressed-pilose below*, *drying olive-green or olive-brown*, paler below; blade elliptic, oblong-elliptic or ovate-elliptic, (3.5–)5–16.5(–19) × (0.9–)1.5–6 cm, base shortly cordate or rounded to obtuse or cuneate, sometimes slightly asymmetric, hardly attenuate, *margin plane to slightly recurved*, *distinctly*, *closely glandular toothed to almost entire with obscure*, *hardly raised teeth*, *apex attenuate*, *acumen 1–2 cm long*; *midrib finely channelled*, pubescent on both surfaces; *lateral veins fine*, (7–)8–10(–12) pairs, *indistinct above*, *looping*, *branching and joining to form a faint* (*sometimes double*) *intramarginal vein*; intercostal venation laxly reticulate; *petiole* 2.5–10 mm long, *often drying dark*. **Inflorescences** axillary, *composed of fascicles to 3.5 cm long of several branched racemes*; *axis appressed-pilose*; *bracts broadly ovate to orbicular*, *boat-shaped*, spreading, often persistent at anthesis, appressed pilose; *bracteoles at base of ovary or sometimes fused with immature fruit*, persistent after anthesis, often minute. **Flowers:** pedicels 1–2.5 mm long; calyx less than 1 mm long, tube almost entirely divided into broadly ovate, moderately to sparsely pilose lobes; corolla oblong, white, glabrous, to 3.5 mm long; *stamens at most 20*, anthers yellow when fresh; disk minutely pilose; ovary with indumentum as inflorescence axis, to 0.7 mm high, style sparsely long-pilose, to 3 mm long. **Infructescence** to 1.8 cm long. **Fruits** *ovoid*, *c. 0.8 × 0.5 cm*, obscurely ridged, glabrescent, ripening blue to black, *with erect*, *apically incurved*, *glabrescent calyx lobes*.

Vernacular names. Sabah—*jiak* (preferred name), *leboh* (Kadazan), *loboh* (Dusun). Sarawak—*girak*, *jirah*, *jirak* (Iban).

Distribution. S Peninsular Thailand and throughout Malesia except the Lesser Sunda Is., Maluku and New Guinea. Widespread in Borneo. In Sabah common, occurring in all districts except those of the extreme northern parts (e.g., *SAN 24402*, *SAN 49936*, *SAN 73054*, *SAN 84271*, and *SAN 131005*). In Sarawak, known from Bintulu, Kapit, Kuching, Lawas, Limbang, Marudi, Miri, Simunjan, Sri Aman, and Tatau districts (e.g., *S 24299*, *S 39916*, *S 46403*, *S 49314*, and *S 60667*). Also occurring in Brunei (e.g., *BRUN 150*, *Coode 7919*, *Sands 5880*, and *Wong WKM 999*) and in Kalimantan (e.g., *Endert 2104* and *Nedi 756*).

Ecology. In primary and secondary mixed dipterocarp and *kerangas* forests, at 10–1700 m altitude, usually on river banks, sometimes on swampy ground, occasionally on slopes, on alluvial sandy or clay soils. One of the most common *Symplocos* species in Sabah and Sarawak.

Uses. The bark is pounded, placed in a bowl, covered with another bowl and left outside the house from dusk to dawn to obtain the condensate, which is then applied to the sore eye. It has also been used by the Dayaks of Borneo to dye rattans.

Notes. *Symplocos fasciculata* is represented in Sabah exclusively by more robust, large-leafed and large-flowered specimens, whereas in Sarawak most specimens are slender and smaller-leafed, with smaller flowers. The variation appears continuous and it has not been possible to differentiate subspecific taxa.

14. **Symplocos goodeniacea** Noot.

(resembling Goodeniaceae; the leaves and habit)

Leiden Bot. Ser. 1 (1975) 204, *op. cit.* (1977) 261, Blumea 31 (1984) 76, *op. cit.* (1986) 277; Whitmore, Tantra & Sutisna *op. cit.* 342. **Type:** *Dewol et al. SAN 74567*, Borneo, Sabah, Sandakan, Labuk Road (holotype L; isotypes K, SAR, SING).

Tree to 25 m tall, to 35 cm diameter. **Bark** lenticellate, hoop-marked, pale brown, *c.* 2.5 cm thick; inner bark yellow to brown or pale greenish. **Sapwood** white or orange-yellow. **Twigs** stout, *curved*, *finely striate*, *glabrous or with a few scattered hairs*, drying pale yellow-brown to green-brown; *young parts grooved to angular*. **Leaves** spirally arranged, loosely clustered at the ends of twigs and more distantly spaced below, coriaceous, slightly glossy, *glabrescent or with a few scattered hairs on both surfaces*, *drying distinctly pale yellow-brown to pale yellow-green or yellow-grey*; blade elliptic to elliptic-oblong or elliptic-obovate, 16–31 × 5–9 cm, base attenuate, decurrent on petiole, *margin plane to recurved*, *obscurely toothed*, *apex shortly acuminate*, *often partially folded when dry*; *midrib deeply channelled above*; *lateral veins* (9–)10–11(–15) pairs, *joining at least towards the apex to form an intramarginal vein*; intercostal venation laxly and finely reticulate; *petiole 18–40 mm long*, *narrowly winged and distinctly channelled above*. **Inflorescences** many-flowered, *basally branched or simple spikes to 5.2 cm long*; axis shortly appressed-pilose; *bracts and bracteoles orbicular-ovate*, slightly keeled, persistent, *ciliate*, glabrescent, to 2 × 2 and 1.5 × 1.3 mm respectively. **Flowers:** calyx glabrous, tube to 0.5 mm long with obtuse to rounded, ciliate lobes to 1.5 mm long; corolla white when fresh, to 8 mm long, lobes oblong, ciliate; ovary glabrous, to 1 mm high; stamens more than 100; disk annular, densely pilose to glabrescent. **Fruits** *inversed pear-shaped*, base almost globose, *c. 1.3 × 1.2 cm*, ridged, neck thick and more strongly ridged than the base, white ripening deep lilac, *with erect*, *apically incurved calyx lobes*.

Distribution. Endemic in Borneo. In Sabah, known from Sandakan and Tawau districts (e.g., *SAN 74567* and *SAN 94875*). In Sarawak, recorded from Semengoh FR, Kuching district (e.g., *S 36534*, and *S 53701*). Also occurring in Bukit Raya, C Kalimantan (e.g., *Veldkamp 8349*).

Ecology. In primary and disturbed mixed dipterocarp forests at altitudes to 150 m on gentle slopes and hillsides on silty clay soils.

15. **Symplocos henschelii** (Moritzi) Benth. *ex* C.B.Clarke Fig. 4.

(A.W.E. Th. Henschel, 1790–1856, Lecturer in Botany at the Breslau University and writer of a key to Rumphius' Herbarium Amboinensis)

In Hooker *f.*, Fl. Brit. Ind. 3 (1882) 588; Brand *op. cit.* (1901) 89, *op. cit.* (1906) 750; Koorders *op. cit. t.* 390; Airy Shaw, Kew Bull.Misc. Inform. (1939) 508; Masamune *op. cit.* 608; Steenis, Bull. Bot. Gard. Buitenz. 3, 17 (1948) 440; Backer & Bakhuizen *f. op. cit.* 204; Nooteboom *op. cit.* (1975) 37, *op. cit.* (1977) 214; Kochummen *op. cit.* 270; Anderson *op. cit.* 328; Whitmore, Tantra & Sutisna *op. cit.* 342; Turner *op. cit.* 480; Coode *et al.* (eds.) *op. cit.* 315; Argent *et al.* (eds.) *op. cit.* 621. **Basionym:** *Cordyloblaste henschelii* Moritzi *op. cit.* 606. **Type:** *Nagel in Herb. Zollinger 3195*, Java, Bandung (L, P). **Synonyms:** *Eugeniodes henschelii* (Moritzi) Kuntze *op. cit.* 975; *Symplocos nagelii* Koord. & Valeton *op. cit.* 159; *S. maingayi* Benth. *ex* C.B.Clarke *op. cit.* 588; *E. maingayi* (Benth. *ex* C.B.Clarke) Kuntze *op. cit.* 975; *Cordyloblaste maingayi* (Benth. *ex* C.B.Clarke) Ridl., *op. cit.* (1923) 309; *S. scortechinii* King & Gamble *op. cit.* 250; *C. scortechinii* (King & Gamble) Ridl., *op. cit.* (1923) 309; *S. dolichantha* Merr., Sarawak Mus. J. 3 (1928) 545.

Tree to 20(–35) m tall, to 40(–60) cm diameter. **Bark** smooth, pale grey, sometimes grey-brown, grey-green or brown, thin, soft; inner bark brittle, yellow. **Sapwood** yellow or pale, moderately hard, moderately heavy. **Twigs** often slightly zigzag, to 6 mm diameter, *glabrous to tomentose*, normally drying pale buff in marked contrast to petioles and leaves; young parts grooved and striate; *older parts terete and almost smooth*. **Leaves** spirally arranged, chartaceous, virtually glabrous above, *hairy to glabrescent below*, drying dark to pale olive-brown to black above, paler olive-brown below, or sometimes patchily greenish-grey, especially above; blade narrowly to broadly elliptic, (5.5–)7–16(–18.5) × (1–)3–6(–7.5) cm, slightly asymmetric at widest point, base cuneate, decurrent as blunt ridges to base of petiole, *margin entire*, *plane to recurved*, *apex acuminate*, *acumen to 2 cm long*; midrib finely channelled above; *lateral veins 5–9 pairs*, distant, indistinct above, usually forming a wide angle with midrib, branching and joining to form an indistinct, double intramarginal vein, tomentose as midrib below; intercostal venation laxly reticulate; *petiole* (*4–*)*7–13 mm long*, shallowly channelled to base, indumentum as or denser than that of twig, normally drying almost black. **Inflorescences** *many-flowered racemes to 6.5 cm long*, in the axils of apical leaves; axis, bracts, bracteoles, calyx, and ovary densely short grey-pilose; bracts and bracteoles ovate, bracts caducous, bracteoles persistent or not, to 5 and 2.5 mm long respectively. **Flowers** sessile or with pedicels to 5 mm long; calyx to 3.5 mm long with triangular to rounded lobes to 1.5 mm long; corolla white and fragrant when fresh, shortly, densely grey-pilose on the outside, to 33 mm long, tube to 23 mm long, lobes spatulate, to 14 mm long; stamens joined in staminal tube for most of their length, anthers yellow; disk absent; ovary to 5 mm high, style green, appressedly white-pilose, more densely so at its bulbous base, stigma yellow. **Infructescences** with 1–3 fruits. **Fruits** *ellipsoid to obovoid*, *to 5 × 2.6 cm*, appressed-pilose to glabrescent, green, with erect calyx lobes surrounding the appressed-hairy, bulbous style base.

Vernacular names. Sarawak—*girak* (Iban), *yum* (Kenyah).

Distribution. Myanmar, Thailand, Indo-China, Sumatra, Peninsular Malaysia, Borneo, the Philippines (Palawan Is.), and W Java.

Ecology. Common in hill mixed dipterocarp, lower montane and upper montane forests and also in high *kerangas* forest, from sea level to 2100 m altitude but seldom found lower than 800 m, on slopes, ridges and plateaux, most commonly on sandy soils.

Uses. Timber is locally used for construction material.

Notes. Nooteboom (*op. cit.* (1975) 39) recognised two subspecies, *viz.* subsp. *henchelii* and subsp. *magnifica* (Fletcher) Noot. Only subsp. *henchelii* with two varieties occur in Sabah and Sarawak.

Key to varieties

Leaves and twig ends glabrous or sparsely hairy, occasionally moderately densely tomentose………………………..…………………………………………………………
.

var. **henschelii**

Synonyms: *Symplocos nagelii* Koord. & Valeton *op. cit.* 159; *S. scortechinii* King & Gamble *op. cit.* 250; *S. dolichantha* Merr., *op. cit.* (1928) 545.

Twigs when hairy with scattered, long, pale appressed hairs, sometimes hairs moderately dense and patent. Leaves virtually glabrous to sparsely appressed-hairy below; 5.5–18.5 × 1.5–6 cm, acumen to 2 cm long; midrib pubescent to virtually glabrous above and sparsely appressed-hairy to glabrescent below. Immature fruit obovoid, to 5 × 2.5 cm.

Distribution as for the species. In Borneo, known from various districts in Sabah (e.g., *SAN 15002*, *SAN 41843*, *SAN 91462*, *SAN 130774*, and *SAN 132763*), Sarawak (e.g., *S 21939*, *S 33860*, *S 39979*, *S 47835*, and *S 50823*), Brunei (e.g., *Prance 30538*, *Prance*

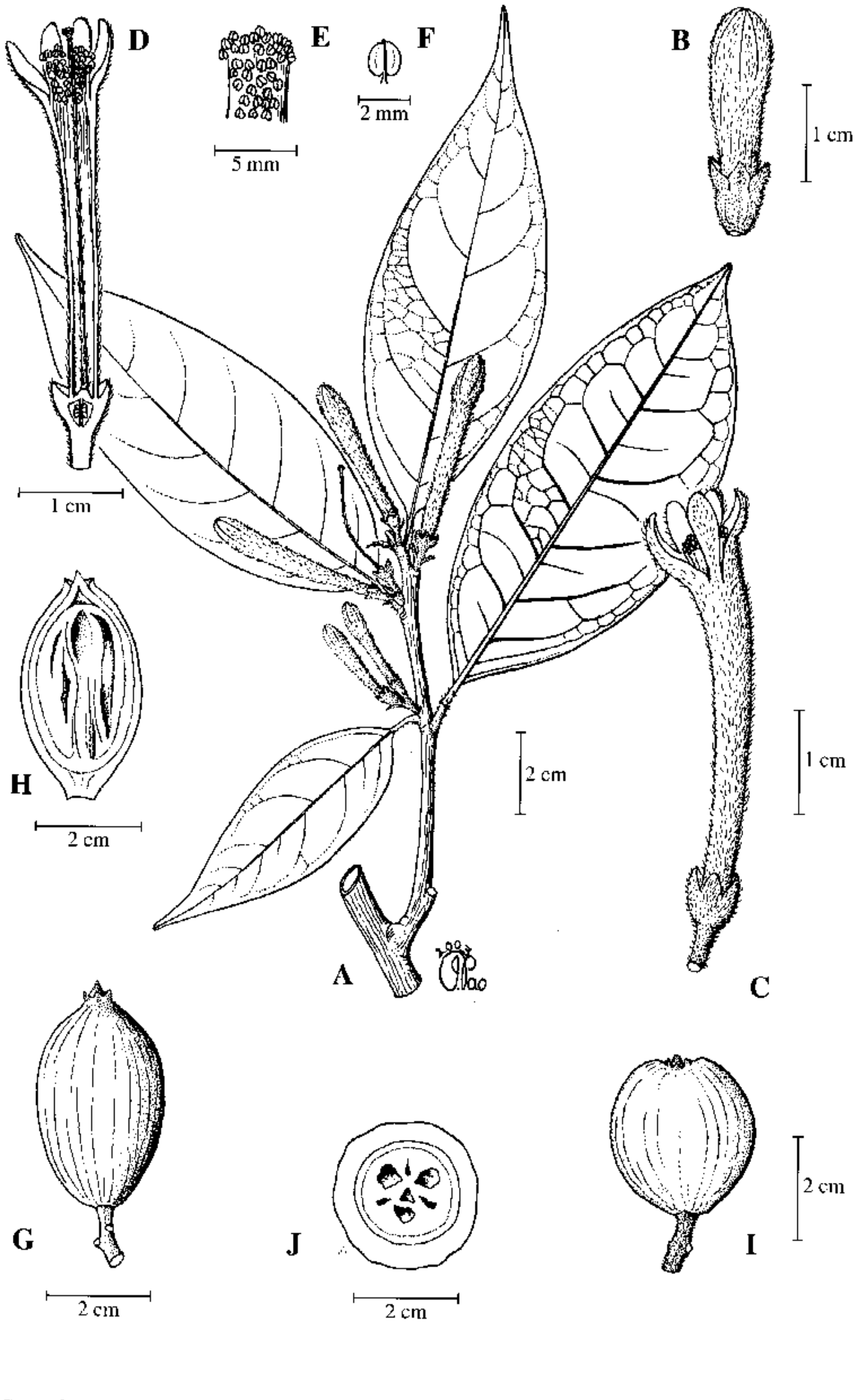

Fig. 4. *Symplocos henschelii*, subsp. *henschelii* var. *henschelii* (A–H) and var. *maingayi* (I–J). A, flowering leafy twig; B, flower bud; C, opening flower; D, longitudinal section of opening flower; E, adaxial view of apical part of staminal tube; F, stamen; G, fruit; H, longitudinal section of fruit; I, fruit; J, cross-section of fruit. (A–B from *S 47835*, C–F from *SAN 132763*, G–H from *SAN 91462*, I–J from *S 37009*.)

30549, *Prance 30564 A*, and *Prance 30610*), and Kalimantan (e.g., *Endert 3926* and *Endert 3969*). Habitat as for the species, at 500–2100 m altitude.

Leaf undersurface patently pale hairy, twig ends densely rufous tomentose………………….

var. **maingayi** (Benth. *ex* C.B.Clarke) Noot.

(A.C. Maingay, 1836–1869, British physician and botanist, sometime jail-warden in Malacca, Peninsular Malaysia)

Leiden Bot. Ser. 1 (1975) 39, *op. cit.* (1977) 214; Kochummen *op. cit.* 272; Anderson *op. cit.* 328. Basionym: *Symplocos maingayi* Benth. *ex* C.B.Clarke *op. cit.* 588. Type: *Maingay Kew Distr. 961*, Peninsular Malaysia, Malacca (holotype K). Synonym: *Cordyloblaste maingayi* (Benth. *ex* C.B. Clarke) Ridl., *op. cit.* (1923) 309.

Twigs with young parts densely rufous or pale brown tomentose; older parts glabrescent. Leaves moderately to densely pale brown pilose below; 8–16.5 × 3.5–7.5 cm, acumen to 1.3 cm long; midrib more or less pubescent above, densely tomentose below. Fruits ellipsoid to slightly obovoid, to 4 × 3 cm.

Peninsular Malaysia, Singapore and Borneo. In Borneo, known from Sabah (e.g., *Pereira JTP 561*), Bintulu, Kuching, Limbang, Marudi, and Miri districts in Sarawak (e.g., *Nooteboom & Chai 1932*, *S 37009* and *S 50679*), Berakas FR in Brunei (e.g., *S 7826*), and from NE Kalimantan (e.g., *Kostermans 9328*). Habitat as for the species, at 20–1700 m altitude.

16. **Symplocos iliaspaiensis** Noot.

(Ilias Paie, plant collector of the Sarawak Herbarium)

Blumea 31 (1986) 279; Whitmore, Tantra & Sutisna *op. cit.* 342. **Type:** *Ilias S 42494*, Borneo, Sarawak, Sri Aman district, Ulu Sg. Silantek Kiri, path to G. Silantek, (holotype L; isotypes A, K, SAR).

Shrub or small tree to 13 m tall, to 20 cm diameter. **Bark** smooth, pale; inner bark white to yellow, thick. **Sapwood** white. **Twigs** *straight or curved*, *grooved*, *usually with fine*, *sharp ridges from petiole base*, terete below, *finely striate*, *glabrous or with scattered white hairs*, *drying pale greenish buff or greenish yellow*. **Leaves** spirally arranged, chartaceous to thin-coriaceous, *appearing bullate due to the raised or sunken lateral veins*, *entirely glabrous or with scattered appressed colourless hairs*, *drying pale grey-green to yellowish grey-green*; blade elliptic, ovate-elliptic or obovate-elliptic, (6.5–)9.5–30.5 × (2.5–)3–8.5 cm, *base cuneate to long-attenuate*, *shortly decurrent on petiole*, *margin* plane to recurved, *shallowly*, *distantly blunt-toothed*, *apex sharply acuminate*, *acumen to 3 cm long*; *midrib narrowly channelled above*; *lateral veins* 5–11 pairs, curved from the base, *finely raised or sunken above*, *looping and joining to form a distinct intramarginal vein 4 mm or more distant from the margin*; *intercostal venation fine*, *closely reticulate*, *raised and prominent on both surfaces*; *petiole 5–20 mm long*, channelled above, *with sharp flanges from decurrent leaf blade*, *diminishing to a finely raised line near petiole base*, glabrous. **Inflorescences** in the axils of upper leaves, *fascicles of sessile flowers or unbranched or branched racemes or fascicles of such racemes to 6.5 cm long*; axis glabrous to moderately densely appressed-hairy; *bracts and bracteoles broadly ovate*, keeled, membranous, pale, *persistent in fruit*, *glabrous or with appressed hairs on keel and ciliate margins*, to 2(–2.5) mm and 1(–1.6) mm long respectively. **Flowers** almost sessile to pedicellate (pedicels to 8 mm long); calyx spreading, yellow when fresh, translucent when dry, to 1.7 mm long, almost completely divided into rounded or broadly ovate, overlapping, glabrous, ciliate lobes; corolla lobes oblong-elliptic, white when fresh, drying pale, glabrous, ciliate, to 5.5 mm long; stamens *c.* 30–100, anthers and filaments yellow; ovary glabrous, to 1.2 mm high, style white when fresh. **Immature infructescences** to 7 cm long. **Immature fruits** *flask-*

shaped with cylindrical neck, *to 1.3 × 0.5 cm*, somewhat ridged, glabrous, pale blue-grey, with erect calyx lobes.

Distribution. Endemic in Borneo.

Ecology. In primary and logged mixed dipterocarp forests, on flat or undulating land or hillsides, at 80–250 m altitude.

Key to varieties

Petiole base somewhat swollen and geniculate. Flowers sessile. Inflorescence axis entirely absent…………………………………………………………………………………………

var. **iliaspaiensis**

Treelet to 3.5 m tall. Leaves 15–30.5 × 4.5–8.5 cm, base long-attenuate, acumen to 3 cm long.

Known only from G. Silantek, Sarawak (e.g., *S 42494* and *S 42517*) in mixed dipterocarp forest at 180–250 m altitude on hillsides.

Petiole base slender and not geniculate. Inflorescences 1.5–6.5 cm long, basally branched or unbranched spikes or racemes or fascicles of such racemes…………………………………..

var. **pedunculata** K.G.Pearce

(Latin, *pedunculatus* = with peduncle; the inflorescence)

Gard. Bull. Sing. 55 (2003) 70. Type: *Fedilis SAN 95642*, Borneo, Sabah, Kalabakan district (holotype SAN; isotypes K, KEP, L, SAR, SING).

Tree to 13 m tall. Petiole slender throughout. Leaves 7.5–20 × 2.5–6 cm, base cuneate, acumen to 1.4 cm long.

In Sabah, known from Kalabakan, Sandakan and Tawau districts (e.g., *SAN 56798*, *SAN 56991*, *SAN 95642*, *SAN 136314*, and *SAN 141166*). Also occurring in Brunei (e.g., *Wong WKM 1079*). In primary and logged mixed dipterocarp forests at altitudes to 80 m, on flat or undulating land or ridges.

17. **Symplocos laeteviridis** Stapf

(Latin, *laetus* = bright, *viridis* = green; the bright green leaves of some dried specimens)

FMK (1894) 205; Brand *op. cit.* (1901) 53; Merrill *op. cit.* (1921) 487; Airy Shaw *op. cit.* 408; Masamune *op. cit.* 609; Heine, Pflz. Samml. Clemens Kinabalu (1953) 88; Nooteboom *op. cit.* (1975) 209, *op. cit.* (1977) 261; Kochummen *op. cit.* 272; Anderson *op. cit.* 328; Whitmore, Tantra & Sutisna *op. cit.* 343; Turner *op. cit.* 480; Coode *et al.* (eds.) *op. cit.* 316. **Type:** *Haviland 1320*, Borneo, Sabah, Mt. Kinabalu, Penokok (holotype K; isotype BO). **Synonyms:** *Symplocos forbesii* Brand *op. cit.* (1901) 63; *S. mjöbergii* Merr., *op. cit.* (1928) 546; *S. kinabaluensis* Heine, Mitt. Bot. Stantssamml. München 6 (1953) 217, Pflz. Samml. Clemens Kinabalu (1953) 88.

Shrub or tree to 23 m tall, *to 20 cm diameter*. **Bark** smooth, brown, green or grey; inner bark green to orange. **Sapwood** white to yellow. **Twigs** *weakly zigzag*, terete; *young parts grooved or striate and pubescent to patently short- or long-pilose to glabrous*; older parts less hairy to glabrescent, medium to dark brown. **Leaves** alternately to spirally arranged, chartaceous to subcoriaceous, *glabrous on both surfaces to variously tomentose below*, *drying olive-green*, *olive-brown or warm-brown*; blade ovate, lanceolate, oblong-ovate, oblong-lanceolate or elliptic, 1.5–13.5 × 0.7–4.5 cm, base cuneate, rounded, obtuse, subcordate or cordate, sometimes somewhat asymmetric, *margin more or less entire to closely*, *bluntly or sharply dentate*, *apex short or long attenuate*, often asymmetric; *midrib channelled above*; *lateral veins 3–9 pairs*, *joining to form looped*, *intramarginal vein*; *petiole 1.5–4 mm long*, variously tomentose. **Inflorescences** *commonly arising simultaneously from the axils of 6–12 or more distal leaves*, *simple or branched racemes*, *pairs of racemes or spikes to 6.5 cm long*; axis hairy to glabrous; *bracts and bracteoles soon caducous*, *appressed hairy*. **Flowers:** calyx lobes hairy to virtually glabrous; ovary appressed hairy to glabrous. **Fruits** *ovoid*, *to 1 × 0.7 cm*, sometimes somewhat curved, smooth to ridged, reddish green ripening blue, *with persistent*, *often somewhat twisted calyx lobes which may be spreading*, *erect and/or incurved on a single fruit*.

Vernacular names. Sabah—*lobo* (Dusun, Kadazan). Sarawak—*buing* (Kenyah), *jirah* (Iban), *lupau* (Kelabit), *luroh* (Kayan).

Distribution. N Sumatra, Peninsular Malaysia, Borneo, and Sulawesi.

Ecology. In mixed dipterocarp, lower to upper montane forests including montane *kerangas* forest, sometimes in disturbed forest, at 10–2900 m altitude, though seldom below 600 m, on hillsides and ridges, sometimes beside streams, on sandy, stony or basalt-derived soils.

Notes. A common and widespread species with at least eight recognisable varieties.

Key to varieties

1. Young twigs and both leaf surfaces glabrous……………………………………………...
    var. **alabensis** K.G.Pearce
    (of G. Alab, Sabah)
    Gard. Bull. Sing. 55 (2003) 71. Type: *Madani & Majawat SAN 119252*, Borneo, Sabah, Penampang district, G. Alab (holotype SAN).
    Treelet to 2 m tall. Leaves lanceolate, to 6 × 2 cm, base cordate; lateral veins 10 pairs; petiole *c.* 1 mm long.
    Only known from G. Alab in Sabah (e.g., the type and *Kamaruddin KMS 1431*).
   Young twigs and at least midrib below hairy……2

2. Leaf base cuneate to rounded, leaves to 5.7 cm long. Young twigs, leaf undersurface and midrib densely rufous appressed pilose……………………………………………
    var. **alternifolia** Noot.
    (Latin, *alterno* = alternate, *folium* = leaf; with alternate leaves)
    Leiden Bot. Ser. 1 (1975) 211, *op. cit.* (1977) 263. Type: *Meijer SAN 20964*, Borneo, Sabah, Ranau district, Bt. Ampuan (holotype L; isotypes K, KEP, S).
    Tree to 8 m tall. Leaves ovate. Fruits pinkish-red.
    Only recorded in Sabah from Mt. Kinabalu, Ranau district, at 1200–1600 m altitude on ultrabasic soil (e.g., *RSNB 288*, *RSNB 4550*, *SAN 111608*, *SAN 123390*, and *SAN 123529*) and G. Trus Madi, Tambunan district (e.g., *Sugau JBS 129*).
   Leaf base cordate; if rounded or cuneate then leaves longer than 6 cm or undersurface not as above………………………………………………………………………….3

3. Leaves 6.5–12 cm long. Twigs velutinous with short, dense, patent tomentum of rufous hairs……………………………………………………………………………………….

var. **velutinosa** Noot.

(Latin, *velutinus* = velvety; the velvety-haired twig)

Leiden Bot. Ser. 1 (1975) 213, *op. cit.* (1977) 263. Type: *Kanis & Kuripin SAN 53955*, Borneo, Sabah, Mt. Kinabalu, above Kiau II, Gurulau spur (holotype L; isotype KEP).

Tree to 10 m tall, to 10 cm diameter. Leaves oblong, base rounded to slightly cordate.

In Sabah, known from Mt. Kinabalu, Ranau district and G. Trusmadi, Tambunan district (e.g., *Clemens 40355*, *SAN 51433* and *SAN 125614*). In Sarawak, occur in Melinau, Kapit district (e.g., *S 25870*), Batu Laga Plateau (e.g., *S 48250*) and Tama Abu Range (e.g., *S 51104*). In old secondary forest at 1000–1600 m altitude on hills on dark brown soil.

Leaves less than 6.5 cm long, or if more then twigs with some long, spreading hair

4. Leaf base cuneate to rounded; most leaves 6 cm or longer…….………………………...

var. **laeteviridis**

Synonym: *Symplocos forbesii* Brand *op. cit.* (1901) 63.

Tree to 23 m tall, to 20 cm diameter. Leaves often drying bright green; blade narrow, lanceolate or oblong-lanceolate to elliptic, apex tapering and long-acuminate.

Sumatra, Peninsular Malaysia, Borneo and SW Sulawesi. In Borneo, widespread and common and known from various localities in Sabah (e.g., *SAN 65017*, *SAN 74483*, *SAN 83999*, *SAN 109990*, and *SAN 131332*), Sarawak (e.g., *S 21895*, *S 22188*, *S 36785*, *S 40900*, and *S 47350*) and Kalimantan (e.g., *bb. 6831*, *Church AC 543*, *Endert 3900*, and *Mogea 3817*). In mixed dipterocarp, *kerangas*, lower to upper montane forests, at 10–2900 m altitude, though seldom below 600 m, usually on slopes and ridges, sometimes besides streams, on sandy, stony or basalt-derived soils.

Leaf base cordate, or if cuneate or rounded then leaves less than 6 cm long………..…5

5. Twigs with an indumentum of spreading hairs at least 1 mm long…………………..…6

Twig indumentum not as above……………………………………………………..7

6. Leaves at least 6 cm long, if less then the base distinctly cordate to 2 mm deep or more………………………………………………………………………………………

var. **mjöbergii** (Merr.) Noot.

(Eric P. Mjöberg, 1882–1938, Director of Sarawak Museum 1922–1924, plant collector)

Leiden Bot. Ser. 1 (1975) 212, *op. cit.* (1977) 263. Basionym: *Symplocos mjöbergii* Merr. *op. cit.* (1928) 546. Type: *Mjöberg 97*, Borneo, Sarawak, G. Murud (holotype UC; isotypes BM, K).

Shrub or tree to 15 m tall, to 15 cm diameter. Leaves often appearing somewhat bullate above due to sunken veins, drying yellow-brown to brown, oblong.

In Sabah, recorded from Kota Belud and Ranau districts (e.g., *SAN 24193*, *SAN 32336*, *SAN 38541*, *SAN 60646*, *SAN 76485*, and *SAN 93908*). In Sarawak, only known in the northern parts from the Kelabit Highlands, including Batu Lawi and G. Murud (e.g., *Nooteboom 1909*, *Nooteboom 2191*, *S 26429*, and *S 50836*). Also occurring in Brunei (e.g., *Niga NN 357*). In hill mixed dipterocarp, lower to upper montane forests at 1300–2000 m altitude, on slopes and ridges on yellow sandy soil.

Leaves to 5(–9.7) cm long, base rounded, or if cordate to less than 1 mm deep……..…..

var. **basirotunda** Noot.

(Latin, *basis* = base, *rotundus* = round; the rounded leaf base)

Leiden Bot. Ser. 1 (1975) 212, *op. cit.* (1977) 263. Type: *Nooteboom & Chai 1819*, Borneo, Sarawak, Kelabit Highlands, trail from Bario to Pa Ukat (holotype L; isotype KEP).

Shrub or treelet to 4 m tall. Leaves oblong to ovate, distinctly sharp-toothed.

In Sabah, known from Mt. Kinabalu, Ranau district and G. Trus Madi, Keningau district (e.g., *Kokawa & Hotta 5762*, *RSNB 1272* and *SAN 71910*). In Sarawak, recorded from Batu Lawi, G. Murud and the Kelabit Highlands, Lawas district (e.g., *Nooteboom 1864*, *Nooteboom 2329* and *S 26302*). Also known from Kalimantan (e.g., *Church AC 657*). In primary or disturbed lower montane forest at 1000–1800 m altitude, on slopes or ridges on sandy, humus-covered soils with rocks and exposed roots.

7. Leaf margin entire, rarely finely toothed, base cuneate to rounded………………..…….

var. **pauciflora** Noot.

(Latin, *pauci* = few or sparse, *flos* = flower; the few-flowered inflorescence)

Leiden Bot. Ser. 1 (1975) 213, *op. cit.* (1977) 263. Type: *Fuchs 21064*, Borneo, Sabah, Mt. Kinabalu (holotype L; isotypes A, K, SAR).

Shrub or treelet to 10 m tall, to 14 cm diameter. Leaves broadly ovate to oblong. Petiole 2–4 mm long. Fruits reddish, ripening blue.

In Sabah, known from Sipitang district (e.g., the type collection and *SAN 132752*) and in Sarawak from Belaga, Lawas, Limbang, and Marudi districts (e.g., *S 32918*, *S 47811*, *S 50917*, *S 51105*, and *S 58294*). Also occurring in Brunei (e.g., *Coode MC 7580*). In hill and lower to upper montane (including *kerangas*) forests at 1200–2500 m altitude on slopes and ridges.

Leaf margin distinctly toothed, base minutely cordate…………………………………..…..

var. **kinabaluensis** (Heine) Noot.

(of Mt. Kinabalu, Sabah)

Leiden Bot. Ser. 1 (1975) 212, *op. cit.* (1977) 263. Basionym: *Symplocos kinabaluensis* Heine, Mitt. Bot. Staatssamml. München 6 (1953) 217. Lectotype (Nooteboom, 1975): *Clemens 29751*, Borneo, Sabah, Mt. Kinabalu (hololectotype K; isolectotypes BM, BO, L, SING).

Shrub or treelet to 7 m tall. Leaves ovate to oblong-ovate, to 5(–6.5) cm long.

Known only from Mt. Kinabalu, Ranau district, Sabah (e.g., *RSNB 2801*, *SAN 26789*, *SAN 32383*, *SAN 114355*, *SAN 117321*, and *SNP 3906*). In montane *kerangas* forest at 1500–2900 m altitude, on hillsides and ridges.

18. **Symplocos odoratissima** (Blume) Choisy *ex* Zoll.

(Latin, *odoratissima* = most fragrant; the flowers)

Syst. Verz. 2 (1854) 136; Koorders & Valeton *op. cit.* 148; Brand *op. cit.* (1901) 35; King & Gamble *op. cit.* 233; Merrill *op. cit.* (1921) 488; Koorders *op. cit. t.* 382; Ridley *op. cit.* (1923) 299; Masamune *op. cit.* 610; Backer & Bakhuizen *f. op. cit.* 205; Nooteboom *op. cit.* (1975) 245, *op. cit.* (1977) 266; Kochummen *op. cit.* 272; Anderson *op. cit.* 328; Whitmore, Tantra & Sutisna *op. cit.* 343; Turner *op. cit.* 481; Coode *et al.* (eds.) *op. cit.* 316; Argent *et al.* (eds.) *op. cit.* 621. **Basionym:** *Dicalyx odoratissimus* Blume *op. cit.* 1116. **Type:** *Blume 1947* (= *RHL Sheet No. 944235499*), Java,

G. Padang (holotype L; isotypes BO, NY, S). **Synonyms:** *Eugeniodes odoratissima* (Blume) Kuntze *op. cit.* 975; *D aluminosa* (*non* Lour.) Blume *op. cit.* 1117, *p.p.*; *S odoratissima* (Blume) Choisy *ex* Zoll. var. *aluminosa* Koord. & Valeton *op. cit.* 150; *S. aluminosa* Brand *op. cit.* (1901) 35; *Pygeum grandiflorum* King, J. As. Soc. Beng. 66, 2 (1897) 228; *S. odoratissima* (Blume) Choisy *ex* Zoll. var. *divaricata* Brand *op. cit.* (1901) 35; *S. pulverulenta* King & Gamble *op. cit.* 234; *S. wenzelii* Merr., Philip. J. Sci. 10 (1915) Bot. 282; *S. trichophlebia* Merr. *op. cit.* (1929) 248 (For further synonyms, *cf.* Nooteboom *l.c.* (1975) 245).

Tree to 28 m tall, to 50 cm diameter. **Bark** smooth to scaly, pale to dark brown or grey; inner bark white to yellow. **Sapwood** yellow to brown. **Twigs** straight to curved; young parts grooved, striate to almost smooth, *puberulous and/or patently pilose to virtually glabrous*, warm to dark brown; *older parts* terete, *striate to almost smooth*, *sparsely to moderately densely patent-pilose*, glabrescent. **Leaves** spirally arranged, chartaceous to coriaceous, *glabrous above*, *glabrous or pilose below*, especially on the veins, drying olive-brown, olive-green or chocolate-brown; *blade* elliptic to obovate-elliptic, *6.5–32 × 2.5–13.5 cm*, base cuneate, acuminate to almost rounded, *margin toothed to entire*, plane to recurved, *apex blunt-tipped acuminate*; midrib finely channelled above; *lateral veins 8–13 pairs*, joining to form an intramarginal vein or only joined at apex; intercostal veins more or less perpendicular to lateral veins; *petiole 6–35 mm long*, shallowly channelled to almost terete, slender to stout, glabrous or puberulous. **Inflorescences** in the axils of apical leaves, *many-flowered panicles 5–17 cm long*, sometimes only branched near base; axis (as also bracts, bracteoles, ovary and calyx) rusty tomentellous; bracts early caducous, to 1.5 mm long; bracteoles caducous, to 1.2 mm long. **Flowers** sessile or with pedicels to 6 mm long, minute; calyx tube 0.3–1 mm long, lobes to 1.5 mm long, blunt; corolla oblong-ovate, white to yellow when fresh, usually tomentellous at least in bud, to 4 mm long; stamens more than 100, anthers yellow when fresh; disk hairy with 5 conspicuous glands; ovary 0.75–1.75 mm high, style pilose towards conical base, *c.* 4 mm long. **Infructescence** often with rather few fruits. **Fruits** pear-shaped, *obliquely ovoid to almost globular*, *8–25 × 5–20 mm*, obscurely ridged, glabrous or tomentellous, ripening blue, with remains of calyx lobes spreading, erect or incurved over the hardly sunken disk and style base; pericarp thin and fleshy or thick and woody.

Vernacular name. Sabah—*lisang* (Dusun).

Distribution. Throughout Malesia except New Guinea. In Borneo found in C and E Sabah, Sarawak, Brunei, and Kalimantan.

Ecology. In primary and secondary mixed dipterocarp forests to 500 m altitude on flat, sometimes swampy land, usually on river banks, sometimes on hillsides on alluvial sandy to loamy soil.

Uses. In Borneo, local people extract salt from the wood ash. The bark is used for dyeing. The inner bark (*kayu* or *kulit seriawan*) is commonly sold in W Java as a medicine for thrush, pounded bark being applied to the gums or bark decoctions used; young leaves are pounded or used for decoctions and used likewise. The pulped leaves are also applied to the abdomen after childbirth and taken internally in a decoction.

Key to varieties

Twigs mostly glabrous. Petiole 6–15 mm long, slender, base not swollen. Leaves 2.5–5.5 cm wide, chartaceous. Fruits 5–10 mm diameter, with thin fleshy pericarp………………..…

var. **odoratissima**

Synonyms: *Dicalyx aluminosus auct. non* Lour.: Blume *op. cit.* 1117; *Symplocos aluminosa* Brand *op. cit.* (1901) 35; *Pygeum grandiflorum* King *op. cit.* 228; *S. odoratissima* (Blume) Choisy *ex* Zoll. var. *divaricata* Brand *op. cit.* (1901) 35; *S. pulverulenta* King & Gamble *op. cit.* 234.

Tree to 27 m tall, to 40 cm diameter. Twigs sparsely patent-hairy to virtually glabrous. Leaves drying dark chocolate-brown, margin plane, coarsely, bluntly, black-gland-tipped toothed except near the base; lateral veins joining to form an intramarginal vein.

Throughout Malesia except New Guinea. In Borneo, known from Kinabatangan, Lahad Datu, Ranau, and Sandakan districts in Sabah (e.g., *SAN 31073*, *SAN 36600*, *SAN 88633*, *SAN 89153*, and *SAN 119889*), Simunjan district in Sarawak (e.g., *S 35656*) and W Kalimantan (e.g., *Kostermans 4848* and *Kostermans 4935*).

Twigs patently pilose or tomentose. Petiole (9–)17–35 mm long, more or less stout, base often swollen. Leaves (4–)5–13.5 cm wide, coriaceous. Fruits 12–20 mm diameter, with thick, woody mesocarp…..……………………………….……………………...……….

var. **wenzelii** (Merr.) Noot.

(C.A.Wenzel, 1882–1929, professional plant collector in Mindanao, the Philippines)

Leiden Bot. Ser. 1 (1975) 248, *op. cit.* (1977) 267. Basionym: *Symplocos wenzelii* Merr., *op. cit.* (1915) 282. Type: *Wenzel 1022*, the Philippines, Leyte (holotype GH; isotypes BM, G). Synonym: *Symplocos trichophlebia* Merr., *op. cit.* (1929) 248.

Tree to 27 m tall, to 50 cm diameter. Twigs sparsely to moderately densely patent-pilose. Leaves drying olive-brown to olive-green, margin plane, recurved or revolute, virtually entire; lateral veins usually not joining to form a distinct intramarginal vein except sometimes at apex.

Sumatra, Borneo, and the Philippines. In Borneo, recorded from Keningau, Kinabatangan, Labuk Sugut, Lahad Datu, Pensiangan, Sandakan, and Tawau districts in Sabah (e.g., *SAN 30117*, *SAN 48959*, *SN 66054*, *SAN 79216*, and *SAN 124714*), G. Api, Ulu Melinau in Sarawak (e.g., *S 30403*), Batu Apoi, Temburong district in Brunei (e.g., *Kirkup 945*), and E Kutei in Kalimantan (e.g., *Kostermans 5790*).

19. **Symplocos ophirensis** C.B.Clarke

(of Mt. Ophir = G. Ledang, Johor, Peninsular Malaysia)

In Hooker *f.*, Fl. Brit. Ind. 3 (1882) 579; King & Gamble *op. cit.* 243; Ridley *op. cit.* (1923) 305; Nooteboom *op. cit.* (1975) 249, *op. cit.* (1977) 267; Kochummen *op. cit.* 272; Anderson *op. cit.* 328; Whitmore, Tantra & Sutisna *op. cit.* 343; Turner *op. cit.* 481. **Lectotype** (Nooteboom, 1975)**:** *Griffith 3650*, Peninsular Malaysia, Malacca, summit of Mt. Ophir (hololectotype K; isolectotype P). **Synonyms:** *Eugeniodes ophirense* (C.B.Clarke) Kuntze *op. cit.* 975; *Symplocos cumingiana* Brand *op. cit.* (1901) 58; *S. perakensis* King & Gamble *op. cit.* 241; *S. caudata auct. non* Wall. *ex* G.Don: Ridley *op. cit.* (1923) 304.

Tree to 30 m tall, to 33 cm diameter. **Bark** smooth, brown or grey; inner bark pale brown. **Sapwood** white to yellow. **Twigs** *straight to curved*, *occasionally obscurely zigzag*, grooved; *young parts virtually glabrous*; *older parts terete and striate*. **Leaves** spirally arranged, chartaceous to thin-coriaceous, glabrous above, *glabrous to sparsely appressed-hairy below*, *drying pale to dark olive-green or olive-brown*; blade ovate-elliptic, elliptic to elliptic-obovate, 4.5–18 × 1.5–8 cm, base acute to obtuse, more or less attenuate, *margin* *almost entire to dentate*, plane to recurved, *apex shortly acuminate to long-attenuate*, *acumen to 2 cm long*, *often curved*; *midrib finely*, *sometimes shallowly channelled above*; *lateral veins* 5–14 pairs, *indistinct above*, *curved towards the margins*, *forming a distinct*, *looped*, *intramarginal vein*, *sometimes with a second*, *less distinct*, *intramarginal vein*; *intercostal venation lax*; *petiole* 3–15 mm long, *channelled or not*, *narrowly flanged to base or nearly to base*, glabrous to sparsely pilose at base. **Inflorescences** *simple or basally branched*, *5–10*(*or more*)*-flowered spikes or racemes*, *to 2.7 cm long*; axis glabrous to more or less appressed-pilose, often less densely so near base; *bracts and bracteoles ovate*, keeled, persistent sometimes to fruiting stage or caducous, appressedly pilose to glabrescent, to 1.5(–4) mm long. **Flowers** minute, sessile or pedicellate with the pedicels to 3 mm long; *calyx* to 1.3 mm long, *lobes rounded to blunt triangular*, *margin usually appearing paler than rest of calyx and ovary*, ciliate, shortly appressed-pilose to almost glabrous at margin, usually markedly less hairy than ovary, or both calyx and ovary virtually glabrous, to 1 mm long; corolla white to yellow when fresh, 2–4.5 mm long; stamens more than 25, anthers yellow when fresh; ovary densely short-appressed-hairy to virtually glabrous, 0.5–1.3 mm high. **Infructescences** *with up to exceptionally five fruits*. **Fruits** *ovoid*, *ovoid-ellipsoid to flask-shaped*, *c. 0.9 × 0.6 cm*, with or without prominent irregular ridges especially near base, virtually glabrous or finely appressed-hairy, ripening blue to deep purple, *with erect or apically incurved calyx lobes surrounding the persistent style base*.

Vernacular names. Sabah—*loboh* (Pensiangan). Sarawak—*entulang jerak* (Iban), *lemasok* (Kenyah).

Distribution. Sumatra, Peninsular Malaysia, Borneo, the Philippines, and Sulawesi.

Ecology. In primary mixed dipterocarp, high *kerangas*, lower and upper montane forests, at 10–1700 m altitude, though usually found at 1200 m and above, on hillsides, ridges and by rivers on alluvial sand and clay-rich soils.

Uses. The timber is locally used to make planks.

Notes. Nooteboom (*op. cit.* (1975) 249) distinguished three subspecies with seven varieties in this species. Of these, only two subspecies with two varieties occur in Sabah and Sarawak.

Key to subspecies and varieties

Leaf elliptic, elliptic-obovate or obovate; margin bluntly to sharply black-gland tipped; lateral veins 8–14 pairs……………………………………………………..……………….

subsp. **cumingiana** (Brand) Noot. var. **cumingiana**

(H. Cuming, 1791–1865, English traveller and naturalist, plant collector)

Leiden Bot. Ser. 1 (1975) 253, *op. cit.* (1977) 268; Anderson *op. cit.* 328. Basionym: *Symplocos cumingiana* Brand *op. cit.* (1901) 58. Type: *Cuming 1463*, the Philippines, Luzon, Prov. Camarines Sud (L).

Tree to 30 m tall. Leaf chartaceous to coriaceous, 7–18 × 2.5–6(–8) cm, *base acute to attenuate*, *decurrent on petiole*; petiole 4–15 mm long.

Distribution and ecology as for the species. In Sabah, known from Keningau, Kinabatangan, Kota Belut, Labuk Sugut, Penampang, Pensiangan, Ranau, Sipitang, and Tambunan districts (e.g., *RSNB 7040*, *SAN 48058*, *SAN 83658*, *SAN 127851*, and *SAN*

131431) and in Sarawak, from Limbang and Marudi districts (e.g., *S 25848*, *S 26361*, *S 50492*, *S 50681*, and *S 55924*). Also recorded from Kalimantan (e.g., *Endert 4135*).

Leaf elliptic to ovate-elliptic, margin obscurely blunt-toothed to almost entire with unraised brown gland dots, lateral veins 5-8 pairs…………………………………………………….…..

subsp. **perakensis** (King & Gamble) Noot. var. **perakensis**
(of Perak, Peninsular Malaysia)

Leiden Bot. Ser. 1 (1975) 254, *op. cit.* (1977) 268; Kochummen *op. cit.* 273. Basionym: *Symplocos perakensis* King & Gamble *op. cit.* 241. Lectotype (Nooteboom, 1975): *King's Collector 10985*, Peninsular Malaysia, Perak (hololectotype L; isolectotypes BM, CGE, W).

Shrub or treelet to 4 m tall. Leaf chartaceous, 5.5–10.5 × 2.5–4 cm, *base broadly acuminate to obtuse*, *hardly decurrent on petiole*, petiole 3–9 mm long.

In Sabah, known from Keningau, Kinabatangan and Pensiangan districts (e.g., *SAN 105254*, *SAN 106872* and *SAN 127989*) and in Sarawak, recorded from Limbang and Miri districts (e.g., *S 21400* and *S 42860*). Also occurring in Brunei (e.g., *Davis APD 514*). Ecology as for the species.

20. **Symplocos pendula** Wight

(Latin, *pendulus* = hanging down; the flowers)

Icon. Pl. Ind. Orient. 4 (1848) *t.* 1237; C.B. Clarke *op. cit.* 587; Brand *op. cit.* (1901) 88; Steenis *op. cit.* 437; Nooteboom *op. cit.* (1975) 40, *op. cit.* (1977) 214; Kochummen *op. cit.* 273; Anderson *op. cit.* 329; Whitmore, Tantra & Sutisna *op. cit.* 343; Turner *op. cit.* 481; Coode *et al.* (eds.) *op. cit.* 316. **Syntypes:** *Herb. Wight 2136*, India, Mt. Pulney (holotype K; isotypes E, L) and *Herb. Wight s.n.*, Sri Lanka (K). **Synonyms:** *Palura pendula* (Wight) Miers *op. cit.* 297; *Eugeniodes pendula* (Wight) Kuntze *op. cit.* 976; *Cordyloblaste pendula* (Wight) Alston, Fl. Ceyl. Suppl. (1931) 188; *Symplocos confusa* Brand *op. cit.* (1901) 88; *Symplocos albifrons* Brand *op. cit.* (1901) 88; *Symplocos capitellata* Brand *op. cit.* (1901) 88; *Symplocos foxworthyii* Brand *op. cit.* (1908) Bot. 3; *Styrax obovatus* Ridl., J. Str. Br. Roy. As. Soc. 61 (1912) 8; *Symplocos crenulata* Ridl., J. Fed. Mal. St. Mus. 6 (1915) 51; *Symplocos pulcherrima* Ridl., *op. cit.* (1915) 160.

Distribution. A species consisting of two varieties distributed in continental SE Asia, throughout Malesia except Java and the Lesser Sunda Islands.

Notes. In Sabah and Sarawak, only var. *hirtistylis* is known. The other variety, var. *pendula*, occurs in Sri Lanka, Deccan, Hainan and Peninsular Malaysia.

var. **hirtistylis** (C.B.Clarke) Noot.
(Latin, *hirtellus* = finely hairy, *stylus* = style; the hairy style)

Leiden Bot. Ser. 1 (1975) 42, *op. cit.* (1977) 215; Kochummen *op. cit.* 273. **Basionym:** *S. henschelii* C.B.Clarke var. *hirtistylis* C.B.Clarke *op. cit.* 588. **Type:** *Maingay 2586*, Peninsular Malaysia, Mt. Ophir (holotype K). **Synonyms:** *Symplocos capitellata* Brand *op. cit.* (1901) 88; *Symplocos confusa* Brand *op. cit.* (1901) 88; *Symplocos henschelii auct. non* Benth.: C.B. Clarke *op. cit.* 588; *Cordyloblaste confusa* (Brand) Ridl., *op. cit.* (1923) 307; *Bobua confusa* (Brand) Kanehira & Sasaki, List Pl. Form. (1928) 330; *Symplocos albifrons* Brand *op. cit.* (1901) 88; *Styrax obovatus* Ridl., *op. cit.* (1912) 8; *Symplocos crenulata* Ridl., *op. cit.* (1915) 51.

Tree to 24 m tall, to 30 cm diameter. **Bark** smooth to rugose, dark brown; inner bark red. **Sapwood** yellow or cream, hard. **Twigs** *crooked or curved*, *terete but with prominently raised petiole scars which when closely set give the twig a knobbly appearance*; young parts striate, sometimes ridged from below persistent petiole scars, sparsely to densely appressed short-pilose, brown to black, often with red tinge; *older parts horizontally cracked*, glabrescent. **Leaves** spirally arranged, thin-coriaceous, glabrous on both surfaces, drying grey-green, olive-brown, chocolate-brown or almost black; *blade elliptic*, *broadly elliptic-obovate to almost orbicular*, 1.5–10 × 1–5 cm, base shortly attenuate to cuneate, decurrent on petiole, *margin inconspicuously to conspicuously distantly blunt-toothed*, plane to recurved, apex shortly blunt to sharp-acuminate to rounded; midrib above finely channelled, glabrescent or pubescent to pilose at least towards leaf base, with scattered appressed hairs, to glabrescent below; lateral veins 5–8(–10) pairs, inconspicuous above, branching towards margin to form an indistinct double intramarginal vein; intercostal venation lax, some almost as prominent as veins below; *petiole* (*1–*)*4–10 mm long*, shallowly channelled with narrow flanges to base, indumentum as twig, more or less rugulose, drying dark. **Inflorescences** 1–5-flowered spikes or racemes to 2.2 cm long; axis contracted, densely appressed buff-pilose (as are bracts, bracteoles, calyx and ovary); bracts and bracteoles triangular, keeled, spreading at anthesis, persistent sometimes to fruit stage or not, to 2 mm and 1 mm long respectively. **Flowers** sessile or occasionally pedicellate with the pedicel to 3 mm long; calyx tube reddish-green when fresh, to 2.5 mm long, including rounded lobes to 1.3 mm long; corolla white, cream or pink and fragrant when fresh, to 13 mm long, forming a tube for part of its length, lobes spatulate, appressed-pilose on outer surface, less densely pilose to glabrous within; stamens joined in a tube for most of their length; ovary to 2 mm high, style base swollen, densely appressed-hairy. **Infructescences** bearing 1 or 2 fruits. **Fruits** ellipsoid, *c. 1 × 0.7 cm*, short-pilose, especially towards the apex, reddish green, with calyx lobes surrounding the protruding, swollen, densely pilose style base.

Vernacular name. Sarawak—*legai* (Iban).

Distribution. Myanmar, Indo-China, China, Japan, Taiwan, and throughout Malesia except Java and the Lesser Sunda Islands. In Sabah, recorded from Keningau, Kota Belud, Penampang, and Ranau districts (e.g., *SAN 29157*, *SAN 32316*, *SAN 56308*, *SAN 87176*, and *SAN 123381*). In Sarawak, known from Bau, Kuching, Limbang, Lundu, and Marudi districts (e.g., *S 35820*, *S 37069*, *S 47909*, *S 47961*, and *S 51023*). Also occurring in Kalimantan (e.g., *Burley 3061*).

Ecology. In high *kerangas* and lower to upper montane forests, at 800–3400 m altitude, typically on exposed mountain summits and also on hillsides. Recorded once on limestone on G. Mulu in Sarawak.

21. **Symplocos polyandra** (Blanco) Brand Fig. 5.

(Greek, *pollos* = many, *andros* = male; with numerous stamens)

In Engler, Pflanzenreich Heft 6 (1901) 436; Merrill *op. cit.* (1921) 488, J. Arn. Arb. 32 (1951) 410; Steenis, Bull. Bot. Gard. Buitenz. 3, 12 (1932) 170; Masamune *op. cit.* 610; Nooteboom *op. cit.* (1975) 264, *op. cit.* (1977) 269; Anderson *op. cit.* 329; Whitmore, Tantra & Sutisna *op. cit.* 343; Coode *et al.* (eds.) *op. cit.* 316; Argent *et al.* (eds.) *op. cit.* 622. **Basionym:** *Guettarda polyandra* Blanco, Fl. Filip. ed. 2 (1845) 500, ed. 3 (1879) 126. **Neotype** (Merrill, 1951)**:** *Ramos & Edano BS 34206*, the Philippines, Luzon, Bulacan Prov., Angat (holoneotype A). **Synonym:** *Symplocos superba* Brand *op. cit.* (1901) 55.

Tree to 32 m tall, to 40 cm diameter. **Bark** deeply or finely fissured or cracked, occasionally scaly or smooth, pale to dark grey or brown to black, hard; inner bark white or pale yellow to brown. **Sapwood** white to pale yellow or brown, moderately heavy. **Twigs** *stout*, straight to curved, tapering, *c.* 5 mm diameter at apex; young parts somewhat angular due to a conspicuous sharp ridge from the base of each petiole scar, *densely short rufous-tomentose* to sparsely puberulous, red-brown; *older parts* more or less terete, *with many prominent*, *heart-shaped petiole scars and ridges from petiole scar bases still apparent*, glabrescent, becoming pale grey-brown. **Leaves** spirally arranged, crowded towards the end of twigs, coriaceous, slightly glossy above, *virtually glabrous or with scattered appressed hairs on both surfaces*, drying olive-brown, olive-green or olive-yellow; blade elliptic-obovate to elliptic-oblong, 9–23 × (3–)4–8.5 cm, base cuneate, attenuate, decurrent as sharp flanges on petiole, *margin entire*, thickened, recurved or not, *apex rounded or bluntly obtuse to bluntly acute*; midrib impressed above, sharp below; *lateral veins 11–14 pairs*, obscure, especially above, branching and joining towards margin to form an indistinct intramarginal vein; intercostal venation laxly reticulate, almost as prominent as lateral veins; *petiole 15–32 mm long*, sharply keeled beneath, sharply flanged to base, rounded and more or less ridged above, indumentum as twig, rugulose, drying dark. **Inflorescences** several to many, occurring on older twigs beneath leaves, *many-flowered spikes 2–8 cm long*; axis densely or sparsely rusty appressed-tomentose, as are bracts, bracteoles, calyx (except towards margins of lobes) and ovary; bracts and bracteoles persistent to fruiting stage, to 2 mm and 1.5 mm long respectively. **Flowers:** calyx to 3 mm long, lobes to 1.5 mm long, rounded and becoming glabrous towards apex; corolla white to cream when fresh, fragrant, glabrous to sparsely pilose on inner surface, to 6 mm long; stamens numerous, anthers yellow when fresh; disk sparsely hairy, pulvinate; ovary to 2 mm high. **Fruits** *ellipsoid-ovoid*, *c. 1.2 × 0.7 cm*, appressed short-tomentose to glabrescent, ripening violet, with erect, persistent calyx lobes.

Vernacular names. Sabah—*bundu-bundo* (Kadazan), *mundu-mundu* (Dusun), *salambuno* (Dusun). Sarawak—*entuyut* (Malay), *jirak* (Iban).

Distribution. Borneo and adjacent islands, the Philippines and SW Sulawesi. In Sabah widespread, known from Beaufort, Kota Belud, Kota Kinabalu, Kudat, Labuan, Papar, Penampang, Sandakan, Sipitang, and Tuaran districts (e.g., *SAN 30269*, *SAN 57841*, *SAN 94418*, *SAN 95142*, and *SAN 133719*). In Sarawak less common, recorded from Bintulu, Kuching and Lundu districts (e.g., *S 17287*, *S 36620*, *S 49870*, *S 59438*, and *S 68034*). Also occurring in Brunei (e.g., *BRUN 943*, *BRUN 944*, *BRUN 15029*, and *Wong WKM 194*) and in Kalimantan (e.g., *Polak 275*).

Ecology. In primary and secondary lowland or *kerangas* forests, from sea level to 170 m altitude, on flat or undulating land, hillsides or ridges, sometimes near streams, also on rocky cliffs, islands and headlands by the sea. Found on poor, well-drained sandy or rocky soils, occasionally on loam or clay and also on humic podzols.

Uses. Timber is locally used for light construction.

22. **Symplocos rubiginosa** Wall. *ex* A.DC. Fig. 6.

(Latin, *rubiginosus* = rusty coloured; the indumentum)

Prod. (1844) 257; C.B. Clarke *op. cit.* 580; Brand *op. cit.* (1901) 53; King & Gamble *op. cit.* 247; Merrill *op. cit.* (1921) 488; Ridley *op. cit.* (1923) 306; Masamune *op. cit.* 610; Nooteboom *op. cit.* (1975) 279, *op. cit.* (1977) 271, *op. cit.* (1984) 76; Kochummen *op. cit.* 273; Anderson *op. cit.* 392; Whitmore, Tantra & Sutisna op. cit. 343; Turner op. cit. 481; Coode et al. (eds.) op. cit. 316; Argent et al. (eds.) op. cit. 622. Type: Wallich 4432, Peninsular Malaysia, Penang (holotype G-DC; isotypes C, CGE, E, FI, K, L, LE, MEL). Synonym: Lodhra rubiginosa (Wall. ex A.DC.) Miers op. cit. 299.

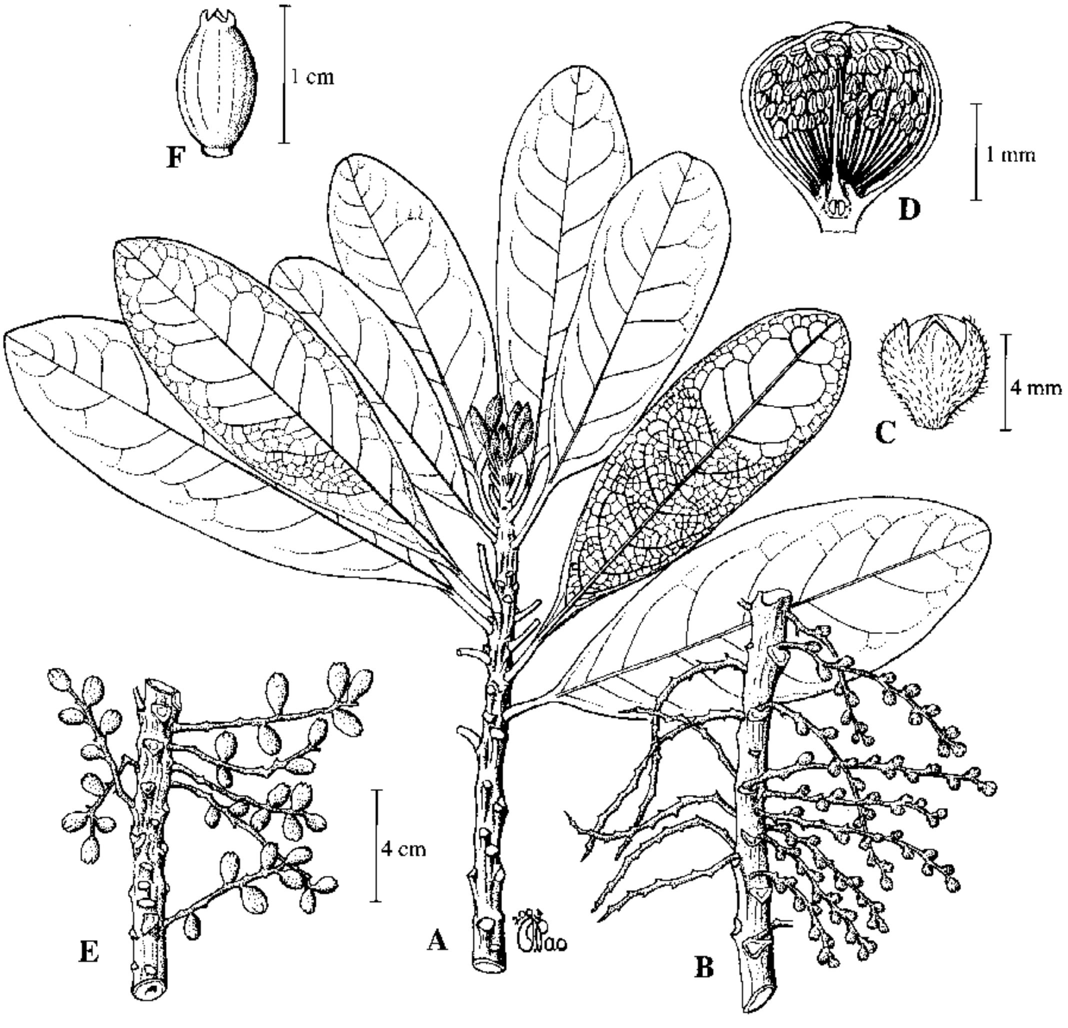

Fig. 5. *Symplocos polyandra.* A, leafy twig; B, lower part of twig with inflorescences; C, flower bud; D, longitudinal section of flower bud; E, lower part of twig bearing infructescences; F, fruit. (A and E–F from *S 42163*, B–D from *SAN A 3070*.)

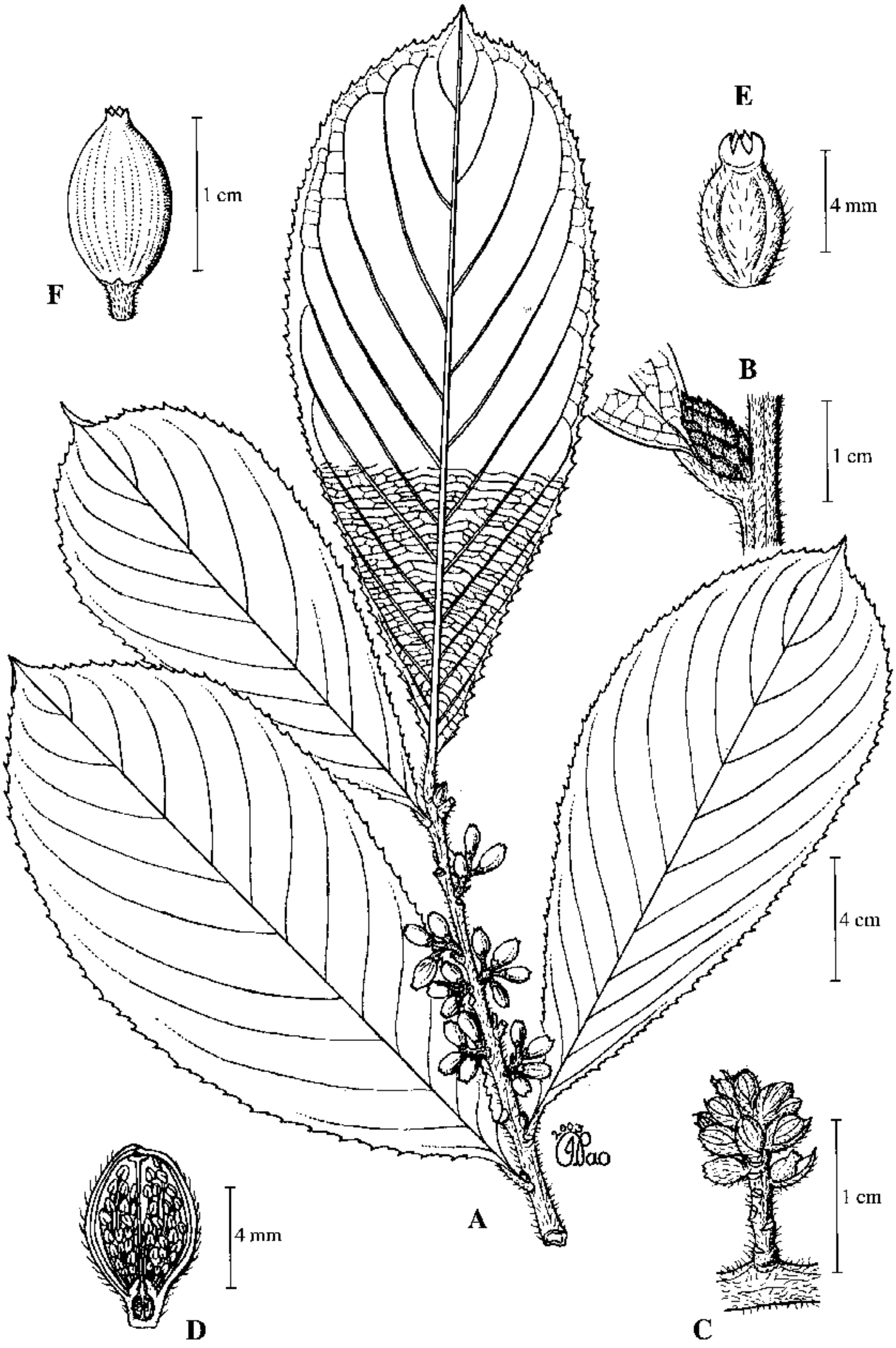

Fig. 6. *Symplocos rubiginosa*. A, fruiting leafy twig; B, young inflorescence; C, older inflorescence; D, longitudinal section of flower bud; E, young fruit; F, mature fruit. (A and F from *S 39238*, B from *S 46063*, C–E from *S 34829*.)

Tree 8–30 m tall, 15–50 cm diameter. **Bark** smooth, brown; inner bark brittle, cream. **Sapwood** pink, soft. **Twigs** *straight*, stout, to 5 mm diameter at apex; *young parts deeply grooved and finely striate*, *densely rufous-tomentose*, pale to warm-brown; *older parts* terete, *without horizontal cracks*, *glabrescent*, pale brown. **Leaves** spirally arranged, sometimes clustered at intervals along twig, chartaceous to thin-coriaceous, virtually glabrous above, *moderately densely appressed to patent-scabrous below*, *especially on midrib and veins*, *drying pale olive-green to yellow-green*; blade elliptic-obovate, 15–40 × 5.5–14 cm, *base cuneate*, shortly decurrent as narrow flanges only at top of petiole, *margin plane*, *coarsely sharply double-toothed*, *apex more or less abruptly acuminate*, *acumen to 2 cm long*; *midrib finely channelled above*, prominent below; *lateral veins* 7–11 pairs, *if joining to form an intramarginal vein then only towards the leaf apex and the intramarginal vein indistinct*; *intercostal venation distinct*, *veins more or less perpendicular to the lateral veins*; *petiole 7–15 mm long*, *flat or scarcely channelled above*, *thickened*, indumentum and colour as twig. **Inflorescences** *in the axils of upper leaves or lower down the twig*, *spikes to 3(–9) cm long*, *bearing 5–10 flowers and appearing cone-like in bud due to overlapping bracts before elongation of axis*; axis tomentose as twig; *bracts* ovate, boat-shaped, *caducous at anthesis* (as are bracteoles), *densely silky-pubescent* (*as are bracteoles*, *calyx and ovary*) to 7 mm long; bracteoles narrowly ovate-oblong, to 3.5 mm long. **Flowers:** calyx to 3.5 mm long, lobes narrowly triangular, *c.* 1.5 mm long, or appearing longer when symmetrically torn at sinus; corolla white when fresh, outer surface sparsely pilose at base, *c.* 6 mm long, lobes oblong-ovate; stamens more than 60; disk glabrous; ovary to 2 mm high. **Infructescence** *with up to 4 fruits*. **Fruits** *ovoid*, *to 1.3 × 0.8 cm*, patently pilose to glabrous, white ripening pale blue and drying pale brown, with erect, persistent calyx lobes.

Vernacular names. Sarawak—*girak*, *jirak* (Iban), *smuak* (Bidayuh).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known in Sarawak from Bau, Belaga, Kapit, Kuching, Lundu, Marudi, Serian, and Sri Aman districts (e.g., *S 19769*, *S 29334*, *S 34829*, *S 41594*, and *S 73798*), Brunei (e.g., *Kirkup DW 888*) and Kalimantan (e.g., *Amdjah 472* and *Teijsmann 8028*).

Ecology. In mixed dipterocarp, *kerangas* and lower montane forests, at 50–1100 m altitude, mostly on hillsides and often on river banks, on yellow, sandy clay loam, limestone and granite rocks.

23. **Symplocos tricoccata** Noot.

(Greek, *tri* = three, *kokkos* = fruit cell; the three-celled fruit)

Leiden Bot. Ser. 1 (1975) 288, *op. cit.* (1977) 272; Kochummen *op. cit.* 274; Anderson *op. cit.* 329; Whitmore, Tantra & Sutisna *op. cit.* 344; Turner *op. cit.* 481; Coode *et al.* (eds.) *op. cit.* 316. **Type:** *Zain SAN 61303*, Borneo, Sabah, Tawau, Hot Spring FR (holotype L; isotypes K, SAN).

Shrub or treelet to 10 m tall, to 15 cm diameter. **Bark** smooth, pale green, pale brown, grey or black; inner bark pale green, yellow or brown. **Sapwood** white, pale yellow or brown, medium hard. **Twigs** *straight or curved*, *occasionally faintly zigzag*, *glabrous*; *young parts shallowly grooved and finely striate*, *drying pale green to pale yellow-green*; *older parts almost smooth and terete*, *drying with brown patches.* **Leaves** spirally arranged, thin-coriaceous, sometimes slightly glossy above, *virtually glabrous or with scattered white hairs on both surfaces*, *drying pale green*, *pale yellow-green or pale grey-green*; blade elliptic to ovate-elliptic, often somewhat asymmetric, 6–29 × 3–13 cm, base shortly attenuate to cuneate, *shortly decurrent on petiole as flanges only near junction with the blade*, *margin* recurved, *sharply or indistinctly brown-gland-tipped toothed with a hardly raised brown gland dot between most pairs of glandular teeth*, *apex acuminate*, *acumen sometimes curved*, *to 2 cm long*; *midrib channelled and glabrous or virtually so above*; *lateral veins* 5–10 pairs, flat or sometimes shallowly channelled above, raised below, *distant*, *ascending near margin but not forming a distinct intramarginal vein except sometimes towards the leaf apex*; *intercostal venation lax*, *more or less transverse to lateral veins*, merging with reticulations, usually distinct and raised above; *petiole 5–15 mm long*, *shallowly channelled almost to base*, glabrous or with some hairs in the channel, drying the same colour as the twig. **Inflorescences** *fascicles or very short spikes or racemes*, 4–8-flowered; *axis* glabrous, *to 0.5 cm long*; *bracts broadly ovate to orbicular*, *boat-shaped*, early caducous (as are bracteoles) ciliate, glabrous or pilose, *c.* 1.75 mm long; bracteoles narrow oblong, ciliate and glabrous, to 0.3 × 1.5 mm. **Flowers** sessile or with the pedicel to 1 mm long; calyx *c.* 2 mm long, *lobes* often spreading to reflexed at anthesis, triangular, *pale yellow-translucent contrasting with darker calyx tube and ovary*, minutely ciliate, glabrous or with some hairs, 1–1.75 mm long; corolla oblong-ovate, white or purple when fresh, translucent, glabrous, to 8 mm long; stamens 40 to more than 100; disk 5-glandular; ovary glabrous, to 2 mm high, style glabrous, conical base with some hairs to softly short-pilose, to 7 mm long. **Infructescences** *with up to 4 fruits*. **Fruits** curved, *ellipsoid-ovoid*, *to 2 × 0.6 cm*, *more or less triangular in cross section with 3 cells defined by grooves* (*sulci*), surface coarsly rugulose, corky, *becoming longitudinally fibrous ridged*, glabrous to sparsely puberulent, white ripening purple to blue, with persistent, erect to apically incurved calyx lobes.

Vernacular name. Sarawak—*atup* (Kenyah).

Distribution. Peninsular Malaysia and Borneo. In Sabah, recorded from Keningau, Kinabatangan, Lahad Datu, Ranau, Sandakan, and Tawau districts (e.g., *SAN 20132*, *SAN 33414*, *SAN 87192*, *SAN 88031*, *SAN 91905*, and *SAN 125631*). In Sarawak, known from Lawas and Marudi districts (e.g., *S 26305* and *S 50914*). Also occurring in Kalimantan (e.g., *Endert 4151* and *Winkler 977*).

Ecology. In lowland to montane primary or disturbed forests, at altitudes to 2300 m, mostly on hillsides, also in low, undulating or flat country, sometimes near streams, on rocky, black or brown soil. The corky, fibrous fruit of this species suggests adaptation for water dispersal.

Uses. In Sarawak, the wood is used to make knife handles.

24. **Symplocos zizyphoides** Stapf

(Latin, *Zizyphus* = the jujube; resembling the jujube)

FMK (1894) 205; Brand op. cit. (1901) 65; Merrill op. cit. (1921) 488; Masamune op. cit. 610; Heine, Pflz. Samml. Clemens Kinabalu (1953) 89; Nooteboom op. cit. (1975) 293, op. cit. (1977) 273; Whitmore, Tantra & Sutisna op. cit. 344. Type: Haviland 1088, Borneo, Sabah, Mt. Kinabalu (holotype K; isotypes BM, BO). Synonym: Symplocos clementis Merr., op. cit. (1917) 111.

Shrub or treelet to 10 m tall. **Twigs** *often distinctly zigzag*, terete, to 5 mm diameter, striate, *appressed brown-pilose*; *older parts* terete, *without horizontal cracks*, *glabrescent*, medium to dark brown. **Leaves** alternate, thin-coriaceous, slightly glossy, finely rugulose above, *virtually glabrous or moderately dense appressed-pilose below*, *drying olive-brown above*, *pale yellow-brown or yellow-green below*; *blade ovate*, *1.5–5.5 × 0.6–2.5 cm*, base cuneate to rounded to slightly cordate, hardly decurrent on petiole, *margin recurved to revolute*, *finely sharp-toothed*, more densely appressed-pilose than the leaf undersurface, *apex shortly acuminate*; *midrib finely channelled above*, appressed pilose below; *lateral veins* (4–)6(–9) pairs, *obscure above*, *merging with the somewhat lax reticulations towards the margin*, *intramarginal vein sometimes discernible*; *petiole 1–2 mm long*, *channelled above*, indumentum as twig. **Inflorescences** *1–4-flowered racemes or flowers solitary*; axis appressed brown-pilose (as are pedicels, bracts and bracteoles); *bracts caducous*, keeled, to 4 mm long; *bracteoles caducous*, 1.5–3 mm long. **Flowers** *shortly pedicellate* except sometimes the uppermost flower, *pedicel 5–12 mm long*; calyx to 2 mm long, *lobes reflexed at anthesis*, *pale*, triangular, ciliate, *sparsely pilose to glabrous*, to 1.5 mm long; corolla white when fresh, glabrous, 4–6 mm long; stamens 40 to more than 100; disk glabrous or with some minute hairs; ovary to 1.5 mm high, style glabrous or with some hairs. **Fruits** *cylindrical-ellipsoid to ovoid*, *1–1.2 × 0.5–0.6 cm*, sometimes slightly curved, moderately dense short-pilose, ripening purple to blackish, drying dark brown.

Distribution. Endemic in Borneo, known mainly from Mt. Kinabalu, Ranau district in Sabah (e.g., *KEP 80388*, *RSNB 5954*, *SAN 23419*, *SAN 117238*, and *SNP 4122*).

Ecology. In open vegetation and primary subalpine shrub-forest, at 2400–3600 m altitude, on hillsides and ridges and in cracks on granite rock faces.

THYMELAEACEAE

C.S. Tawan

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Bentham & Hooker *f.*, Gen. Pl. 3 (1883) 186; Hooker *f.*, Fl. Brit. Ind. 5 (1890) 192; Gamble, J. As. Soc. Beng. 75, 2 (1912) 256; Merrill, EB (1921) 416; Ridley, FMP 1 (1922) 321 ('Gonystylaceae'), FMP 3 (1924) 143; Domke, Bibl. Bot. 27, Heft 111 (1934) 30, 33, 103; Masamune, EPB (1942) 510; Airy Shaw, FM 1, 4 (1953) 349; Ding Hou, FM 1, 6 (1960) 1; Backer & Bakhuizen *f.*, FJ 2 (1965) 267, FJ 2 (1965) 401 ('Gonystylaceae'); Whitmore, TFM 2 (1973) 383; Cockburn, TS 1 (1976) 251; Anderson, CLTS (1980) 332; Corner, WSTM 3rd. edition 2 (1988) 729; Turner, Gard. Bull. Sing. 47 (1995) 484; Kessler & Sidiyasa, TBSA-EK (1994) 225; Coode *et al.* (eds.), CLBD (1996) 320; Argent *et al.* (eds.), MNDT-CK 2 (1997) 630.

Trees, shrubs, climbers, rarely herbs. **Wood** often with included phloem. **Bark** fibrous and tough. **Leaves** opposite, decussate, spiral or alternate, simple, entire, without stipules, with or without translucent glandular dots, mostly pinnately veined. **Inflorescences** terminal, axillary, extra-axillary, or sometimes on brachyblasts borne on the tree trunk or older branches, simple or branched, sessile or peduncled, paniculate, thyrsoid, racemose, umbellate, spicate, capitate, fasciled or condensed into glomerules, with or without bracts. **Flowers** bisexual, radially symmetrical; calyx tubular, campanulate or cupular, 4–5(–6)-lobed, aestivation imbricate or valvate or rarely equitans; corolla absent or represented by petaloid appendages of the same number and alternating with the calyx lobes or twice the number and arranged in pairs opposite calyx lobes, fleshy or membranaceous, filamentous or oblong, entire or lobed, free or rarely united into a ring, inserted at the throat of calyx tube or slightly lower; stamens 2, 4 or many, in one or two (rarely three) whorls, if in 2 whorls then inserted at 2 different levels, filaments filiform or slightly flattened, anthers 2-loculed, basifixed or dorsifixed, obtuse or apiculate, introse; disk hypogynous, membranaceous or subcarnose, annular, cupular, lobed, free and scale-like, or absent; ovary superior, 1–2-loculed or 3–5(–8)-loculed, sessile or short-stalked, style filiform, caducous, sometimes very short or obscure, terminal or excentric, sometimes provided with parastyles at the base, stigma capitate, subglobose, oblong, subclavate or pyramidal, entire or sometimes emarginate, sometimes pillose; ovules solitary in each locule, with an axial or parietal placentation, pendulous from the top. **Fruit** a drupe or drupaceous, a berry or a capsule, either apically or laterally emerging from the calyx tube; pericarp membranaceous, pulpy, coriaceous or fibrous. **Seeds** 1–2(–3) per fruit, with a caruncle-like or tail-like appendage or an aril, with or without endosperm; testa usually crustaceous, black, often with irregular ridges, smooth or with short hairs; embryo straight, cotyledons plano-convex, radicle short and superior.

Distribution. The family consists of about 50 genera with 500 species of almost comospolitan distribution but chiefly develop in tropical Australia and Africa. In Sabah and Sarawak, nine genera with 45 species (including 2 incompletely known species) are recorded.

Ecology. In Sabah and Sarawak, most species of the Thymelaeaceae occur in mixed dipterocarp, freshwater, peatswamp, and *kerangas* forests, at low to medium altitudes. A few, e.g. *Linostoma pauciflorum* and *Phaleria capitata*, occur in lowland to lower montane forests at altitudes to 1300 m, while *Wikstroemia brachyantha* is confined to lower and upper montane forests at 1200–2800 m altitude, and *Drapetes ericoides* is restricted to subalpine vegetation at altitude above 3000 m (Mt. Kinabalu).

Uses. The whitish and light wood of several species of *Aquilaria* and *Gonystylus* is the main source of *karas* and *ramin* timber, respectively. The timber is highly prized and popular for making decorative cabinets and various types of interior decorative items. It is also suitable for veneer, plywood, block-board and particle-board manufacture. The *gaharu*, which is also known under trade names of agarwood or Malayan eaglewood or Malayan aloeswood, is the resin-containing heartwood of old and infected/diseased trees of several species, e.g. *Aëtoxylon sympetalum*, *Aquilaria beccariana*, *Aquilaria malaccensis*, *Enkleia malaccensis*, *Wikstroemia polyantha*, and *W. tenuiramis*. Of these, the wood of *Aquilaria malaccensis* is the most important source. In Asia, fragrance produced by burning the wood is widely used as incense for religious, ceremomial purposes. Essential oil extracted from *gaharu* wood and known commercially as agarwood oil is utilised in oriental, luxury perfumery industries. The silvery tough inner bark of *Aquilaria malaccensis*, *E. malaccensis*, *Phaleria capitata*, and *W. tenuiramis* is highly valued for its strength and durability and locally used for cloth, ropes and other binding material. (*cf.* PROSEA 5, 1 (1993) 221; *ibid.* 19 (1999) 64, 173, 183, and descriptions under genera and species for further information).

Taxonomy. Domke (*op. cit.* (1934) 103) subdivided the Thymelaeaceae into four subfamilies, *viz.* Aquilarioideae, Gilgiodaphnoideae, Gonystyloideae, and Thymelaeoideae, and placed *Gonystylus* in the family. The subdivision of the family as well as the placement of *Gonystylus* in it, which have been adopted by a number of subsequent authors, e.g., Airy Shaw (*op. cit.* 1953, FM 1, 6 (1972) 976), Ding Hou (*op. cit.* 1960), Whitmore (*op. cit.* 1973), Cockburn (*op. cit.* 1976), Brummitts (Fam. Gen. Vasc. Pl. (1992) 679), Turner (*op. cit.* 1995), Coode *et al.* (*op. cit.* 1996), Argent *et al.* (*op. cit.* 1997), Mabberley (PB (1998) 713), are accepted in the present treatment. Apart from the subfam. Gilgiodaphnoideae, the other three subfamilies have representatives in Sabah and Sarawak. The major distinguishing characters and the disposition of genera occurring in Sabah and Sarawak in the above subfamilies, are as follows:

Subfam. **Aquilariodeae:** Leaves without translucent glandular dots. Flowers with a short cylindrical calyx tube or sepals free; petaloid appendages scale-like, free or rarely united, inserted at the throat of the calyx tube or slightly below it, or absent; stamens at most 10, arranged in one or two whorls, filaments partly or entirely adnate to the calyx tube; disk absent, or ring-shaped; ovary 2-loculed; parastyles absent. Fruit a capsule. Seeds usually with conspicuous chalazal fold and a thin funicle, without aril; endosperm absent or present. The genus occurring in Sabah and Sarawak placed under this subfamily is *Aquilaria*.

Subfam. **Gonystyloideae:** Leaves with translucent glandular dots. Flowers with a short or inconspicuous calyx tube; petaloid appendages 8–65, deltoid to linear-subulate, rarely joined into a low, entire ring, inserted at the base of calyx tube; stamen 8–65, in one or two or three whorls; filaments free; disk absent; ovary (2–)3–5(–8)-loculed; parastyles sometimes present. Fruit a capsule, 3–5-valved. Seeds without chalazal fold, usually with orangy-reddish fleshy aril; endosperm absent. Genera included in this subfamily are *Aëtoxylon*, *Amyxa* and *Gonystylus*.

Subfam. **Thymelaeoideae:** Leaves without translucent glandular dots. Flowers with funnel-shaped or cylindrical calyx tube; petaloid appendages obscure and rigde-like or represented by scales; stamens at most 10, usually in two whorls, rarely in one whorl; filaments partly or entirely adnate to the calyx tube; disk absent; ovary 1–2-loculed; parastyles absent or present. Fruit a drupe or drupaceous. Seeds mostly without a small chalazal fold; endosperm absent.

Genera in Sabah and Sarawak placed under this subfamily are *Drapetes*, *Enkleia*, *Linostoma*, *Phaleria*, and *Wikstroemia*.

Key to genera

(based on sterile specimens)

1. Leaves with translucent glandular dots……………………………………………..…2
   Leaves without translucent glandular dots...4

2. Leaves opposite or decussate………………………………………….…**1. Aëtoxylon**
   Leaves alternate or spiral…………………………………………………………..…3

3. Lateral veins of leaves few in number, well-spaced, curving and disappearing towards margins..…**2. Amyxa**
   Lateral veins of leaves numerous, more or less parallel and straight, arching and forming intramarginal veins near margins……………………………………….…**4. Gonystylus**

4. Leaves sessile, linear, small, 0.3–0.5 × 0.1 cm; lateral veins 5–9, more or less parallel to the midrib……………………………………………………………………………………

   Drapetes Banks *ex* Lam.

   (Latinised Greek word, *drapetes* = illusive, deceptive)

   J. Hist. Nat. Paris 1 (1792) 188; Stapf, FMK (1894) 221; Gibbs, J. Linn. Soc. Bot. 42 (1914) 132; Merrill, EB (1921) 417; Masamune, EPB (1942) 511; Ding Hou, FM 1, 6 (1960) 43; Cockburn, TS 1 (1976) 251.

   Dwarf shrubs with creeping, radiating or more or less tufted stems. *Leaves* subopposite or spiral, *sessile*, *narrowly linear*, *without translucent glandular dots*, *with 5–9 striated longitudinal veins*. Flowers aggregated in small, sessile, terminal heads; pedicels short, articulated at apex; calyx tube pilose outside, glabrous inside, caducous, lobes 4, slightly spreading; petaloid appendages (0–)1–2, scale-like, inserted at the mouth of calyx tube; stamens 4, alternate with calyx lobes; ovary 1-loculed, style linear, lateral, caducous, stigma capitate and papillose when young. Fruits small drupes with thin pericarp. Seeds closely enveloped by the endocarp.

   A genus comprising four species distributed in Borneo (Sabah), New Guinea, Australia (including Tasmania), New Zealand, and S America (Fuega and Falkland Is.). In Sabah, the genus is represented by *D. ericoides* Hook.*f.*, which is confined to subalpine vegetation on Mt. Kinabalu at 3000–4000 m altitude.

   Leaves at least 1.5 cm long, pinnately veined, not linear, petiolate……………………..…5

5. Lateral and intercostal veins more or less parallel………………………………………6
   Lateral veins curved; intercostal veins reticulate or scalariform...................................…7

6. Leaves alternate or spiral. Shrubs, treelets or trees…………………………**3. Aquilaria**
   Leaves opposite, rarely subopposite. Climbers or rarely shrubs or small trees…………..

   Linostoma Wall. *ex* Endl.

   (Greek, *linon* = flax, *i.e.* plant with long and small leaves, *stoma* = opening; alluding the long and narrow cleft of the calyx tube)

   Gen. Pl. (1837) 331; Bentham & Hooker *f.*, Gen. Pl. 3 (1883) 197, *p.p.*; Domke, Bibl. Bot. 27, Heft 111 (1934) 120; Ding Hou, FM 1, 6 (1960) 26; Nevling, J. Arn. Arb. 42 (1961) 295.

Woody climbers, *rarely shrubs*. *Leaves opposite or subopposite*, *without translucent glandular dots*; *lateral veins fine and parallel*. Inflorescences umbellate or paniculate, few-flowered, axillary or terminal on lateral branches; bracts 2(–4), opposite or alternate. Flowers: calyx tube cylindric, lobes 5, imbricate then spreading; pedicels articulated at base; petaloid appendages 10, long, club-shaped or filiform, inserted at the throat of calyx tube; stamens twice as many as calyx lobes, unequal, free; disk obscure, sometimes appearing as a shor-toothed ring at the base of ovary; ovary stipitate, style filiform, long, stigma capitate. Fruits surrounded by the cleft base of calyx tube; pericarp crustaceous. Seeds with membranaceous testa.

A genus with about six species distributed in Myanmar, Thailand, Indo-China, Sumatra, Peninsular Malaysia, and Borneo. In Sabah and Sarawak, the genus is represented by two species (*L. longiflorum* Hallier *f.* and *L. pauciflorum* Griff.), occurring in lowland mixed dipterocarp, peatswamp and lower montane forests, at altitudes to 1300 m.

7. Leaves alternate…………………………………………………………………………

Enkleia Griff.

(Greek, *enkleiein* = enclosed; the fruit being surrounded at base by the torn remain of calyx tube)

Calc. J. Nat. Hist. 4 (1844) 234; Gamble, J. As. Soc. Beng. 75, 2 (1912) 262; Ridley, FMP 3 (1924) 147; Merrill, PEB (1929) 212; Masamune, EPB (1942) 511; Ding Hou, FM 1, 6 (1960) 23, *ibid.* (1972) 982.

Woody climbers often provided with hooks. Leaves *alternate*, *without translucent glandular dots*, pinnately veined; *lateral veins curved*; *intercostal venation subscalariform*. Inflorescences paniculate, terminal, lax, few-flowered; bracts conduplicate or involute, linear, lanceolate or oblong, subopposite, opposite or alternate. Flowers 5-merous; pedicels articulated at base; calyx tube cylindric, lobes puberulous on both sides; petaloid appendages twice as many as calyx lobes, inserted at the throat of calyx tube; stamens twice as many as calyx lobes, in two whorls, sessile, subsessile or with short filaments; disk absent or obscure, sometimes represented by minute scales; ovary sessile, style terminal, distinct, stigma oblong. Fruits prominently ribbed, enclosed at base by the torn remains of calyx tube; exocarp thin, endocarp hard. Seeds with membranaceous testa.

A genus comprising three species, distributed in the Andaman Is., Myanmar, Thailand, Indo-China, Sumatra, Peninsular Malaysia, Borneo, the Philippines, and New Guinea. In Sabah and Sarawak, the genus is represented by one species (*E. malaccensis* Griff.), occurring in lowland forest.

Leaves strictly opposite or decussate………………………………………………..…8

8. Leaves smaller, *c.* 13 × 4 cm……………………………………..…**6. Wikstroemia**
Leaves larger, 11–26 × 3.5–10 cm……………………………………..…**5. Phaleria**

Key to genera

(based on flowering and/or fruiting specimens)

1. Leaves with translucent glandular dots. Stamens free. Petaloid appendages inserted on the receptacle. Fruits 3–5(–8)-loculed…………………………………………………..…2

Leaves without translucent glandular dots. Stamens and petaloid appendages adnate to or inserted on the calyx tube. Fruits 1–2-loculed……………………………………….….4

2. Leaves decussate, sometimes subopposite. Inflorescences subumbellate. Calyx lobes valvate. Petaloid appendages fused into a ring…………………………….….**1. Aëtoxylon**
Leaves spiral or alternate. Inflorescences thyrsoid, paniculate or racemose. Calyx lobes imbricate or subvalvate. Petaloid appendages 7–65…………………………………......3

3. Leaves with a few, lax lateral veins. Petaloid appendages 10, more or less in pairs. Parastyles subulate-corniform (= horn-shaped). Fruits long-beaked…………...**2. Amyxa**
Leaves with numerous parallel lateral veins. Petaloid appendages 8–65, not in pairs. Parastyles, if present, very small and clavate. Fruits not beaked……………**4. Gonystylus**

4. Stamens of the same number as calyx lobes......................................**Drapetes** (see above)
Stamens twice the number of calyx lobes..…………………………………………..5

5. Fruit a loculicidal capsule. Petaloid appendages usually distinct and densely pubescent or puberulous………………………………………………………….….**3. Aquilaria**
Fruits drupaceous. Petaloid appendages, if present, always glabrous.................................6

6. Ovary 2-loculed (rarely one locule abortive). Fruits (1–)2-seeded. Petaloid appendages absent or if present, obscure and rim-like…………………………….....…**5. Phaleria**
Ovary always 1-loculed. Fruits 1-seeded. Petaloid appendages not as above.....................7

7. Erect shrubs or small trees. Inflorescences without leafy bracts. Petaloid appendages absent. Ovary glabrous or only hairy at the top……………………………**6. Wikstroemia**
Usually climbers. Inflorescences usually provided with 2 leafy bracts on each branch. Petaloid appendages well-developed. Ovary densely pubescent…………………………8

8. Stamens in two whorls. Style obscure or shorter than ovary………..…**Enkleia** (see above)
Stamens in one whorl. Style several times as long as ovary......……**Linostoma** (see above)

1. **AETOXYLON** Airy Shaw

(Greek, *aetos* = eagle, *xulon* = wood; the eaglewood)

gaharu, *gaharu buaya*, *ramin batu* (Malay)

Kew Bull. (1950) 145, FM 1, 4 (1953) 365; Anderson, CLTS (1980) 332; Argent *et al.* (eds.), MNDT-CK 2 (1997) 630. **Synonym:** *Gonystylus* Teijsm. & Binn. sect. *Aëtoxylon* Airy Shaw, Kew Bull. (1947) 10.

Medium-sized trees. **Leaves** *decussate*, *opposite or sometimes subopposite*, *thick-coriaceous*, glabrous, *with translucent glandular dots*; venation numerous, very distinct. **Inflorescences** few-branched, axillary or terminal, *subumbellate*, tomentose; bracts absent. **Flowers** 5-merous, long-pedicelled; pedicels long-sericeous; calyx cupular, divided to about halfway, *lobes valvate*, slightly reduplicate, equal, setulose within; *petaloid appendages fused into a low*, *entire*, *slightly fleshy ring*, *inserted on the receptacle*; *stamens* 10–15, *free*, filaments short and slender, anthers basifixed, subspherical, 4-loculed; ovary sessile, 5-loculed, densely setulose; style filiform, wiry, contorted, pilose, stigma capitate; ovules apical, pendulous,

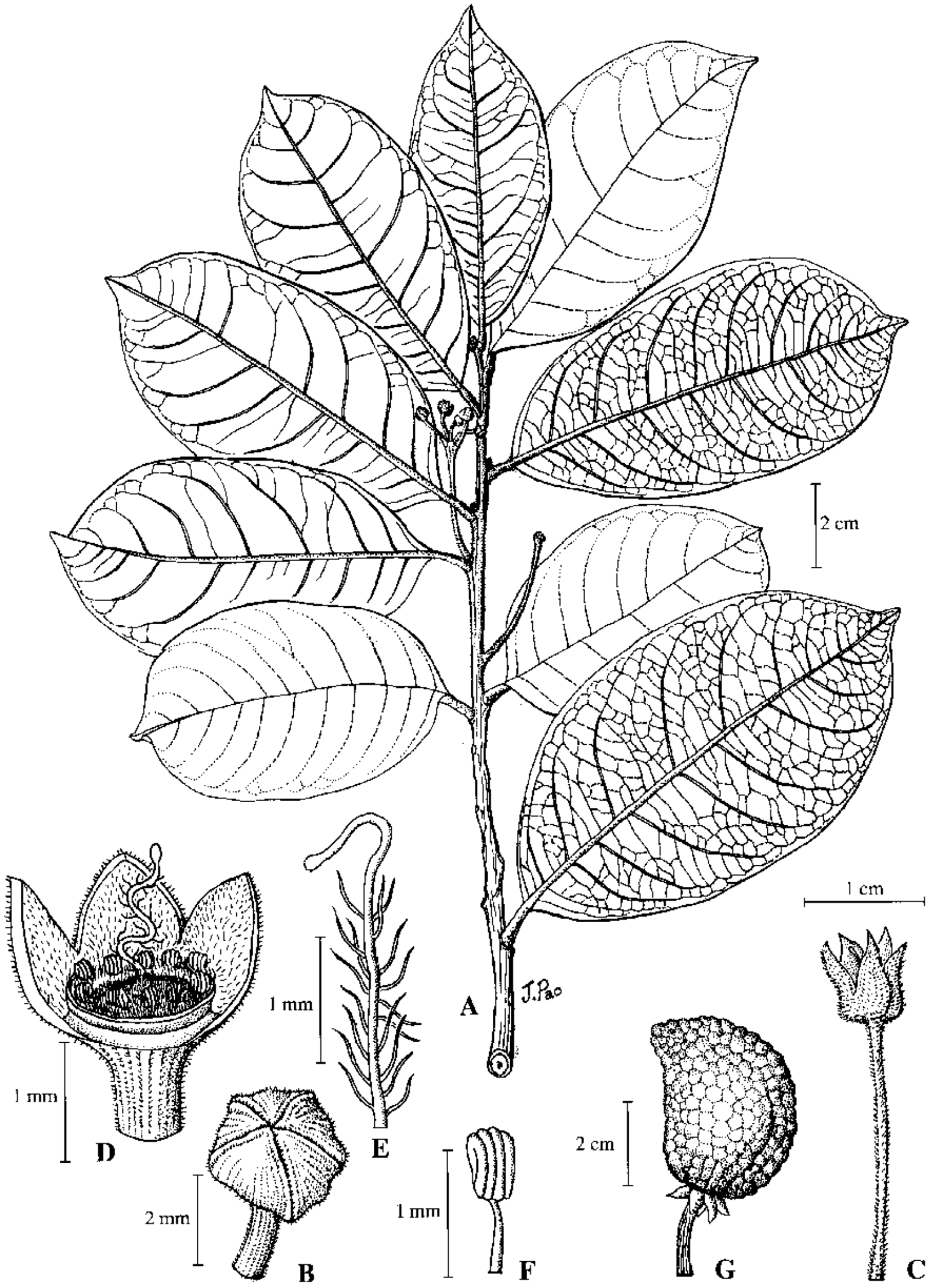

Fig. 1. *Aetoxylon sympetalum.* A, flowering leafy twig; B, flower bud; C, open flower; D, longitudinal section of open flower; E, style and stigma; F, stamen; G, fruit. (A–F from *S 9630*, G from *S 4655*.)

solitary. **Fruits** 1–3-seeded capsules, *3–5*(*–8*)*-loculed*, subglobose or subpyriform, thin-walled, verrucate, tomentose, ferruginous or dull brown, dehiscent. **Seeds** subglobose; testa crustaceous, smooth, greyish brown, stony; endosperm absent.

Distribution. A monotypic genus endemic in Borneo and found only in Sarawak and Kalimantan.

Aetoxylon sympetalum (Steenis & Domke) Airy Shaw Fig. 1, Plate 6A.

(Latin, *sympetalum* = having united petals)

Kew Bull. (1950) 145, *op. cit.* (1953) 365; Anderson *op. cit.* 332; Argent *et al.* (eds.) *op. cit.* 630. **Basionym:** *Gonystylus sympetala* Steenis & Domke, Notizbl. Bot. Gart. Berlin 12 (1934) 233, Domke, Bibl. Bot. 27, Heft 111 (1934) 7, 33, 145, Airy Shaw *op. cit.* (1947) 10. **Type:** *Soelaiman bb. 17222*, Borneo, W Kalimantan, Kampung Mawa, Sanggau (holotype BO; isotypes KEP, L).

Tree 18–40 m tall, 30–60 cm diameter; trunk straight, sometimes with fluted base; buttresses absent. **Bark** finely fissured, warty, dark brown or almost black. **Twigs** terete, blackish, glabrous. **Leaves** drying brown to greyish brown above, dark brown below; blade elliptic, oblong or obovate, 6–13 × 2.5–5.5 cm, base obtuse, margin strongly revolute, apex acuminate or rarely retuse; midrib narrowly channelled above, rounded and prominent below; lateral veins 7–15 pairs, obscure on both surfaces; intercostal venation densely reticulate; petiole 0.7–0.9 cm long, glabrous, rugose, dark brown when dry. **Inflorescences** 2–5 cm long, bearing 5–6 flowers, glabrous. **Flowers:** pedicels 2–2.3 cm long, tomentose; buds subglobose, 5–6 × 4–4.5 mm, tomentose; calyx lobes deltoid, 2.5–3 × 1.5–2 mm, tomentose outside, densely velutinous within; petaloid appendage glabrous, 2–3 mm long; stamens *c.* 10, 1–1.5 mm long, free, in a single whorl, filaments 0.5–1 mm long, anthers *c.* 0.5 mm long, glabrous; ovary ovoid, *c.* 2 mm long, style *c.* 3 mm long. **Fruits** globose or subglobose, 4.3–5 cm diameter; pericarp thin, partly fibrous, rough, sparsely stellate, reddish brown hairy. **Seeds** ellipsoid, *c.* 3 cm long, with numerous oil ducts; testa smooth, cream-coloured to brownish, crustaceous; embryo very small.

Distribution. In Sarawak, fairly common and recorded from Kuching, Lundu, Serian, and Sri Aman districts (e.g., *S 4655*, *S 9598*, *S 9627*, *S 11711*, and *S 17452*). Also known from W Kalimantan (e.g., *bb. 16446*, *bb. 16703*, *Becking 16*, and the type).

Ecology. In lowland mixed dipterocarp and *kerangas* forests, at altitudes to 100 m.

Uses. In Sarawak, the infected heartwood is a very important source of *gaharu* incense. In Kalimantan, oil known as *minyak garu laka* is extracted from the heartwood.

2. **AMYXA** Tiegh. *ex* Domke

(Greek, *a* = without, *muxa* = exudate, mucilage; referring to the wood)

ramin bukit (Malay)

Bibl. Bot. 27, Heft 111 (1934) 116; Airy Shaw, Bull. Misc. Inform. Kew (1940) 261, Kew Bull. (1950) 146, FM 1, 4 (1953) 363; Ding Hou FM 1, 6 (1960) 47; Anderson, CLTS (1980) 332; Coode *et al.* (eds.), CLBD (1996) 120; Argent *et al.* (eds.), MNDT-CK 2 (1997) 631.

Small to medium-sized trees. **Leaves** *alternate*, chartaceous, *with translucent glandular dots*; *lateral veins lax*, *arching and disappearing towards margins*, obscure. **Inflorescences** *much-branched thyrses*, terminal or axillary, bearing numerous small tomentose flowers; bracts present; bracteoles absent. **Flowers:** pedicels long and sericeous, articulate at base; calyx tube short and broadly cup-shaped, *lobes* 5, unequal, deltoid, *imbricate*, tomentose on both surfaces; *petaloid appendages 10*, *in pairs alternating with calyx lobes*, *inserted on the receptacle*, subulate, setulose; *stamens 10*, *free*, alternating with petaloid appendages, filaments short, anthers rounded, basifixed, 4-loculed; ovary sessile, 3–5-loculed, style elongate, filiform, contorted, stigma capitate; *parastyles 5–7*, *subulate-corniform*, attached at the base of the style; ovules solitary in each locule, anatropous, pendulous. **Fruits** *3–5*(*–8*)-*loculed*, 2-seeded, stalked, *long-beaked*, tomentose, thin-walled, dehiscent capsules. **Seeds** large, without endosperm; testa thinly coriaceous, smooth; funicle thickened but not expanded into an aril.

Distribution. A monotypic genus endemic in Borneo.

Amyxa pluricornis (Radlk.) Domke Fig. 2, Plate 6B.

(Latin, *pluri* = many; *cornis* = horns; referring to the presence of many horn-shaped parastyles at the base of style).

Bibl. Bot. 27, Heft 111 (1934) 116; Airy Shaw *op. cit.* (1940) 261, *op. cit.* (1950) 146, *op. cit.* (1953) 363; Ding Hou *op. cit.* 47; Cockburn, TS 1 (1976) 253; Anderson *op. cit.* 332; Coode *et al.* (eds.) *op. cit.* 320; Argent *et al.* (eds.) *op. cit.* 631. **Basionym:** *Gonystylus pluricornis* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Akal. Wiss. München 16 (1887) 16; Merrill, EB (1921) 372; Hallier *f.*, Med. Rijksherb. 44 (1922) 155; Masamune, EPB (1942) 447. **Type:** *Beccari PB 563*, 'Borneo' (holotype M). **Synonyms:** *Amyxa kutcinensis* Tiegh., Ann. Sci. Nat. Bot. 7 (1893) 248; *A. taenoicera* Airy Shaw *op. cit.* (1950) 146.

Tree 10–21 m tall, 10–30 cm diameter. **Bark** reddish brown. **Twigs** terete, slender, rugose, glabrescent, dark brown. **Leaves** glabrous, drying brown; blade elliptic or obovate, 8–15 × 3–5 cm, base cuneate-attenuate, margin slightly revolute, apex acuminate; midrib impressed above; lateral veins 6–11 pairs, slender, obscure above, prominent below, sparsely tomentose; intercostal venation reticulate, obscure on both surfaces; petiole 0.8–1.6 cm long, glabrous, rugose, dark brown when dry. **Inflorescences** 8–27 cm long, each branch bearing 4–7, alternately arranged, clusters of flowers, each cluster consists of 3–6 flowers, densely tomentose; bracts linear, 5–8 × 2.5–3 mm, tomentose. **Flowers:** pedicels 3–3.5 mm long, tomentose; buds subglobose, 3–3.5 × 3–3.5 mm; calyx lobes 3–4 × 1.5–3.5 mm, tomentose on both sides, strongly recurved at anthesis; petaloid appendages subulate, 1.5–2 × 1 mm, epustulate, densely to moderately setulose, fleshy, rigid, reddish brown when dry; stamen *c.* 1.5 mm long, free, in a single whorl, filaments *c.* 0.5 mm long, anthers *c.* 1 mm long, glabrous; ovary ovoid, densely tomentose, styles *c.* 6 mm long, glabrous; parastyles *c.* 2 mm long, provided with 2–3 setae at the apex. **Fruits** 5–6 cm long, 3–4-valved, pericarp striate, densely shortly brown-velvety. **Seeds** oblong-ellipsoid, *c.* 3 × 1–1.5 cm, more or less plano-convex; cotyledons thick and fleshy, with numerous oil ducts; radicle conical.

Distribution. In Sabah, recorded from Beaufort, Labuk Sugut, Penampang, and Sipitang districts (e.g., *SAN 15064*, *SAN 50083*, *SAN 65225*, and *SAN 134077*) and in Sarawak, from Belaga, Bintulu, Kapit, Kuching, Marudi, Miri, Serian, and Sibu districts (e.g., *Jacobs 5376*, *S 15880*, *S 21408*, *S 34316*, and *S 41538*). Also occurring in Brunei (e.g., *BRUN 3088*, *BRUN 3157*, *Coode MC 6806*, *Dransfield JD 6845*, and *Forman LLF 871*) and Kalimantan (e.g., *Burley*, *Tukirin et al. 3166*, *Kostermans 10310*, *Kostermans 10674*, and *Mogea & de Wilde 4105*).

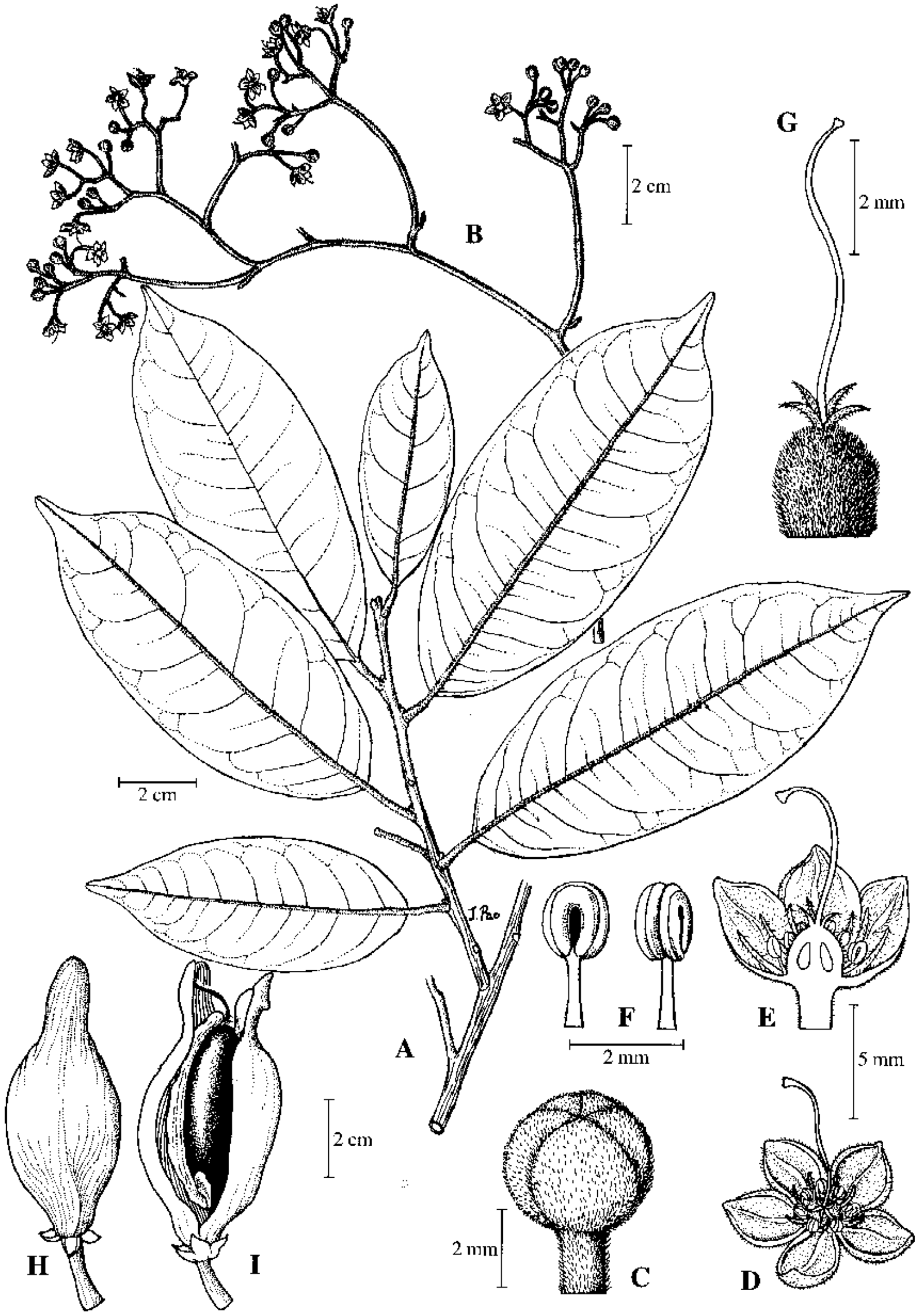

Fig. 2. *Amyxa pluricornis.* A, leafy twig; B, inflorescence; C, flower bud; D, open flower; E, longitudinal section of open flower; F, stamens; G, gynoecium; H, fruit; I, dehiscing fruit. (A and H–I from *S 16671*, B–G from *S 24740*.)

Ecology. In primary mixed dipterocarp forest on yellow sandy soil, at altitudes to 800 m.

Uses. In Sarawak, the timber is used for making planks.

3. **AQUILARIA** Lam.

(Latin, *aquila* = an eagle; Malayan eaglewood)

gaharu (preferred name), *engkaras* (Iban), *karas* (Malay),
lako (Punan Tutoh), *tangala* (Berawan)

Encycl. 1 (1783) 49; Domke, Bibl. Bot. 27, Heft 111 (1934) 118; Gamble, J. As. Soc. Beng. 75, 2 (1912) 263; Ridley, FMP 3 (1924) 147; Ding Hou, FM 1, 6 (1960) 6; Whitmore, TFM 2 (1973) 365; Cockburn, TS 1 (1976) 253; Anderson, CLTS (1980) 332; Corner, WSTM 3rd. edition 2 (1988) 729; Kessler & Sidiyasa, TBSA-EK (1994) 225; Turner, Gard. Bull. Sing. 47 (1995) 484; Coode *et al.* (eds.), CLBD (1996) 321; Argent *et al.* (eds.), MNDT-CK 2 (1997) 631. **Synonyms:** *Aquilariella* Tiegh., Ann. Sci. Nat. Bot. 7 (1893) 216; *Aquilaria* Lam. sect. *Agallochum* Hallier *f.*, Med. Rijksherb. 44 (1922) 15; *Aquilaria* Lam. sect. *Gyrinopsis* Hallier *f.*, *op. cit.* 16; *Aquilaria* Lam. sect. *Amphinoman* Hallier *f.*, *op. cit.* 18.

Trees, *treelets* or *shrubs*; young parts pubescent, glabrescent. **Bark** smooth, pale whitish, stripping off in long, fibrous pieces; inner bark white, cream, grey or pale brown, homogenous, without glistening fibres. **Leaves** *alternate*, *pinnately veined*, *petioled*, *without translucent glandular dots*, fibrous, drying not brittle; *lateral and intermediate veins* distinct or obscure, simple or sometimes branched, *more or less parallel and running directly into the intramarginal veins*; *intercostal venation subscalariform*. **Inflorescences** axillary, supra-axillary, terminal, or rarely borne on the tree trunk or older branches, sessile or short-peduncled, simple or rarely branched, umbellate or paniculate; bracts few and small or absent. **Flowers** 5-merous, pedicelled; pedicels articulated at base; calyx spliting on one side, outside glabrescent, inside puberulous with reflex hairs arranged in lengthwise lines towards the upper part, tube cup-shaped, cylindrical or bell-shaped, lobes (4–)5(–6), reflex or straight, usually shorter than or rarely as long as the calyx tube; *petaloid appendages distinct*, twice as many as calyx lobes, free or united into a ring, *inserted at the throat of calyx tube*, lanceolate, ovate, semi-orbicular, each pair opposite calyx lobes, *densely pubescent or puberulous*; *stamens twice as many as calyx lobes*, *inserted at or slightly below the throat of calyx tube*, filaments short or filiform, sometimes slightly swollen at the upper end, anthers linear-oblong, dorsifixed, free; disk none or rarely ring-like; ovary sessile or stalked, ovoid, oblanceolate or ellipsoid, densely short-puberulous, 2-loculed, style terminal, obscure or distinct, gradually dilated towards the ovary, densely puberulous towards the base, stigma distinct, globose, capitate, pyramidal or oblong; *parastyles absent*; ovules attached at the top of the septum and partly adnate to it. **Fruits** *loculicidal capsules*, *1–2-loculed*, globose-obovoid or ablanceolate, rugose or smooth, sometimes slightly compressed laterally, protruding either from the top or from the split side of the calyx tube, distinctly stalked, densely puberulous to glabrous; pericarp coriaceous or woody. **Seeds** 1–2 per fruit, ovoid or ellipsoid; testa crustaceous, bearing a caruncle-like or tail-shaped appendage at the base; funicle obscure or distinct; cotyledons thick, plano-convex.

Distribution. About 15 species, distributed in India, Myanmar, Indo-China, SE China, and widespread in SE Asia. In Borneo, five species occur, of which four (3 well-known and 1 incompletely known) are recorded from Sabah and Sarawak.

Ecology. In lowland to lower montane forests, at altitudes to 1700 m.

Uses. Resin-containing heartwood obtained from old and infected/diseased trees of several *Aquilaria* species, e.g., *A. beccariana*, *A. crassna* Pierre *ex* Lecomte (from Thailand and Indo-China), *A. malaccensis*, and *A. sinensis* (Lour.) Sprengel (from SE China) is the most important source of *gaharu* or *karas* wood (also known, under the trade-names of agarwood, Malayan eaglewood or aloeswood). The fragrance produced by the burning of the wood has been highly valued for thousand of years, and its use as incense for ceremomial purposes in Buddhism, Confucianism and Hinduism is widespread throughout E and SE Asia. In western, Chinese and Indian medicines, the incense is used against cancer, especially of the thyroid gland. In China, it is applied as a sedative against abdominal complaints, asthma, colics and diarrhoea, and as aphrodisiac and carminative. The well-known agarwood oil is an essential oil extracted from the agarwood. The oil is used in luxury oriental prefumery. The timber of undiseased trees is very light and is suitable for making boxes, light indoor construction and veneer. The silvery inner bark is highly valued for its strength and durability and is used for making ropes and cloth. (*cf.* PROSEA 19 (1999) 64, for further details).

Key to *Aquilaria* species

1. Leaves generally larger, 7–27 × 3–8 cm; lateral veins (10–)15–28 pairs, strongly raised above. Calyx tube cylindrical. Petaloid appendages oblong, puberulous. Ovary with a distinct accrescent stalk of *c.* 2 mm long. Fruits ellipsoid-obovoid, narrowed towards the base into an elongated stalks, 10–12 mm long……………………….…**1. A. beccariana**
   Leaves generally smaller, 4–12 × 1.5–5 cm; lateral veins 12–19 pairs, flat or obscure above. Calyx tube campanulate. Petaloid appendages ovate-oblong, oblong or linear, densely hairy. Ovary without stalk. Fruits obovoid or obovoid-oblong, base cuneate or subcordate, without distinct stalk……………………………………………………………2

2. Fruits larger, 3–4 × 2.5 cm, base cuneate. Seeds with a tail-like, slightly twisted, pubescent funicle………………………………………………………………..…**2. A. malaccensis**
   Fruits smaller, 0.8–1.2(–1.6) × 1–1.2(–1.5) cm, base subcordate. Seeds with caruncle-like, glabrous appendages of *c.* 2 mm long…………………………………...…**3. A. microcarpa**

1. **Aquilaria beccariana** Tiegh. Fig. 3.

(Odoardo Beccari, 1843–1920, Italian explorer and botanist)

Ann. Sci. Nat. Bot. 7 (1893) 217; Merrill, EB (1921) 416; Masamune, EPB (1942) 510; Ding Hou *op. cit.* (1960) 13; Whitmore *op. cit.* 385; Cockburn *op. cit.* 253; Anderson *op. cit.* 332; Turner *op. cit.* 484; Coode *et al.* (eds.) *op. cit.* 321; Argent *et al.* (eds.) *op. cit.* 632. **Type:** *Beccari PB 2339*, Borneo, Sarawak (isotype L; fragments). **Synonyms:** *Aquilaria grandifolia* Domke, Notizbl. Berl. Bot. Gart. 11 (1932) 348; *A. cumingiana* (Decne.) Ridl. var. *parvifolia* Airy Shaw, Bull. Misc. Inform. Kew (1940) 261; *Gyrinopsis grandifolia* (Domke) Quisumb., J. Arn. Arb. 27 (1946) 406.

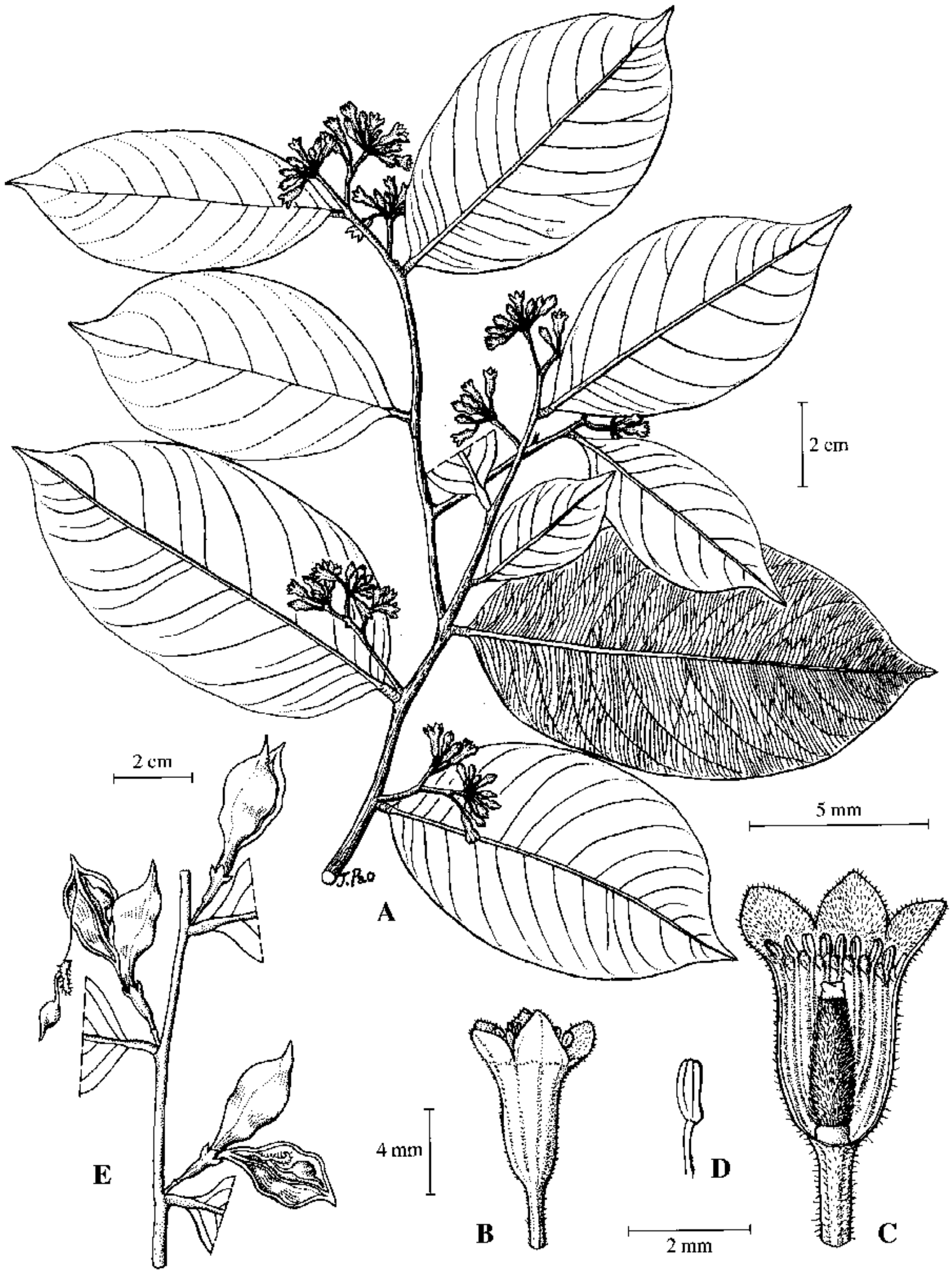

Fig. 3. *Aquilaria beccariana*. A, flowering leafy twig; B, open flower; C, longitudinal section of open flower; D, stamen; E, fruiting leafy twig. (A–D from *S 23015*, E from *S 27069*.)

Tree to 20 m tall, to 36 cm diameter; trunk sometime fluted at base. **Bark** smooth, pale grey, finely, irregularly fissured; inner bark creamy white, soft. **Twigs** greyish green, pubescent when young. **Leaves** chartaceous, glabrous; *blade* oblong, oblong-lanceolate or elliptic-oblong, *7–27 × 3–8 cm*, base cuneate to attenuate, apex acute to acuminate; *lateral veins* (*10–*)*15–28 pairs*, curving and ascending towards the margins, elevated and prominent below, *distinctly raised above*; intercostal venation lax; petiole 0.5–0.7 cm long, pubescent. **Inflorescences** umbellate, axillary or extra-axillary, branched; peduncle to 1.5 cm long, bearing to 6 flowers, pubescent. **Flowers:** *calyx tube cylindrical*, 0.7–1.2 cm long, 10-ribbed, sparsely hairy outside, lobes ovate, 2–3 mm long, puberulous; *petaloid appendages oblong*, *c.* 1 mm long, *densely puberulous*; stamens usually sessile, rarely with very short filaments; *ovary* ellipsoid, attenuate at base, narrowing towards apex, *with a distinct stalk c. 2 mm long*, stigma small, capitate. **Fruits** protruding from the top of calyx tube, *ellipsoid-obovoid*, 2–3.5 × 1.5 cm, *narrowed towards the base into an elongated stalk*, 10–12 mm *long*, usually slightly contracted in the middle, glabrescent. **Seeds** black, ovoid, *c.* 1 × 0.5 cm, sparsely puberulous, apex acuminate; appenlage bold densely pubescent, 3–4 mm long; stalk 3–4 mm long, blackish.

Vernacular names. Sarawak—*engkaras* (Iban), *gaharu*, *karas*, *kekaras* (Malay).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah, recorded from Beaufort, Kinabatangan, Lahad Datu, Pensiangan, Sandakan, and Tenom districts (e.g., *SAN 15218*, *SAN 31084*, *SAN 114524*, *SAN 120302*, and *SAN 130012*) and in Sarawak, from Bintulu, Kuching, Marudi and Miri districts (e.g., *S 23015*, *S 38014* and *S 71531*). Also occurring in Brunei (e.g., *Argent 91290*, *Coode MC 7648*, *Dransfield JD 7281*, *FMS 34453*, and *Simpson 2029*) and Kalimantan (e.g., *bb. 34916*, *Endert 3319*, *Kostermans 13204*, and *Purseglove P 4752*).

Ecology. In mixed dipterocarp forest on yellowish sandy loam soils, rarely in swampy forest, at altitudes to 1000 m.

2. **Aquilaria malaccensis** Lam. Plate 6C.

(of Malacca, Peninsular Malaysia)

Encycl. 1 (1783) 49; Gamble *op. cit.* 264; Merrill *op. cit.* 417; Ridley *op. cit.* 147; Masamune *op. cit.* 511; Ding Hou *op. cit.* (1960) 9, Blumea 12 (1964) 286; Whitmore *op. cit.* 385; Cockburn *op. cit.* 253; Anderson *op. cit.* 332; Corner *op. cit.* 729; Kessler & Sidiyasa *op. cit.* 225; Turner *op. cit.* 484; Argent *et al.* (eds.) *op. cit.* 632. **Type:** not solved. **Synonyms:** *Aquilaria agallocha* Roxb., Fl. Ind. ed. Carey 2 (1832) 422, Ding Hou *op. cit.* (1964) 286; *Agallochum malaccensis* (Lam.) Kuntze, Rev. Gen. Pl. 2 (1891) 583; *Aquilariella malaccensis* (Lam.) Tiegh., Ann. Sci. Nat. Bot. 7 (1893) 216.

Tree to 40 m tall, to 60 cm diameter. **Bark** smooth, whitish grey. **Twigs** slender, pale brown, pubescent, glabrescent. **Leaves** chartaceous to subcoriaceous, glabrous above, sparsely pubescent below, shining on both surfaces; *blade* elliptic-oblong to oblong-lanceolate, *6–7 × 3–4 cm*, base acute, attenuate or obtuse, apex acuminate, acumen to 2 cm long; *lateral veins 12–16 pairs*, often branched, prominent below, *flat or obscure above*; intercostal venation distinct below, obscure above; petiole 0.3–0.6 cm long. **Inflorescences** terminal, axillary or supra-axillary, usually branched with 2–3 umbels, each umbel bearing *c.* 10 flowers; peduncle 5–15 mm long. **Flowers:** pedicels slender, 3–6 mm long; *calyx tube campanulate*, 5–6 mm long, green or pale green, sparsely puberulous outside, glabrous within, distinctly 10-ribbed, *lobes ovate-oblong*, 2–3 mm long, densely puberulous within, reflexed; *petaloid appendages ovate-oblong*, *c.* 1 mm long, slightly incurved, *densely pilose*; stamens 1–2 mm long, epipetalous ones longer than the others, anther obtuse; *ovary* ovoid, 1–1.5 mm long, *without stalk*, densely pubescent; style obscure, stigma capitate. **Fruits** *obovoid to obovoid-oblong*, *3–4 × 2.5 cm,* rounded at apex, *cuneate at base*, *without distinct stalk*, usually compressed, pubescent, glabrescent; pericarp woody, suture *c.* 6 mm wide. **Seeds** ovoid, including the beak *c.* 1 × 0.6 cm, hairy, *with tail-like*, *slightly twisted*, *pubescent funicle*.

Vernacular names. Sabah and Sarawak—*gaharu* (Malay). Sarawak—*engkaras* (Iban).

Distribution. India, Myanmar, Sumatra, Peninsular Malaysia, Singapore, Borneo, and the Philippines. In Borneo, known in Sabah from Kinabatangan, Sandakan and Tawau districts (e.g., *SAN 63887*, *SAN 83381* and *SAN A 3158*) and in Kalimantan (e.g., *Kostermans 5976*, *Kostermans 9547* and *Sidiyasa 459*).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 270 m.

3. **Aquilaria microcarpa** Baill.

(Greek, *mikros* = small, *karpos* = fruit; with small fruit)

Adansonia 11 (1875) 304; Merrill *op. cit.* 417; Masamune *op. cit.* 511; Quisumbing *op. cit.* 403; Whitmore *op. cit.* 385; Cockburn *op. cit.* 254; Anderson *op. cit.* 332; Turner *op. cit.* 484; Argent *et al.* (eds.) *op. cit.* 632. **Type:** *Beccari PB 2886*, Borneo, Sarawak (isotype L; fragment). **Synonyms:** *Aquilariella microcarpa* (Baill.) Tiegh., Ann. Sci. Nat. Bot. 7 (1893) 216, Bull. Soc. Bot. Fr. 40 (1893) 217; *A. borneensis* Gilg, Nat. Pflanzenfam. 11, 6a (1894) 224, Merrill *op. cit.* 417.

Tree *c.* 21 m tall, *c.* 25 cm diameter. **Bark** greyish, superficially fissured. **Twigs** brownish, pubescent. **Leaves** subcoriaceous, shining and glabrous above, dull brown and sparsely pubescent below; *blade* elliptic-oblong to obovate-oblanceolate, *5–7.5 × 2.3–3.5 cm*, base cuneate to attenuate, apex acute to acuminate, acumen to 1 cm long; *lateral veins 12–19 pairs*, sometimes branched, slightly curved and ascending to the thickened margins, prominent below, *flat or obscure above*; petiole 0.3–0.5 cm long, pubescent. **Inflorescences** axillary, supra-axillary or terminal or on short lateral branchlets, usually branched, rarely simple; peduncle to 1 cm long, 6–7-flowered. **Flowers** white to cream; pedicels *c.* 5 mm long, puberulous; *calyx tube campanulate*, *c.* 5 mm long, puberulous outside, sparsely puberulous inside, lobes ovate-oblong, obtuse, densely puberulous on both surfaces; *petaloid appendages linear*, *c. 1 mm long*, *hairy*; stamens to 1.5 mm long, anthers *c.* 0.5 mm long; *ovary* densely pubescent, *without stalk*, style 1.5–2 mm long, stigma capitate. **Fruits** *subcordate*, slightly compressed, *0.8–1.2*(*–1.6*) × *1–1.2*(*–1.5*) *cm*, *without distinct stalk*, 1(–2)-seeded. **Seeds** ovoid, *c. 0.6 × 0.4 cm*, hairy; *caruncle-like funicle c. 2 mm long*, *glabrous*.

Vernacular names. Sarawak—*engkaras* (Iban), *gaharu* (Malay).

Distribution. Sumatra, Singapore and throughout Borneo. In Sabah, recorded from Beaufort, Sandakan and Tawau districts (e.g., *FMS 38762*, *SAN 15204*, *SAN 16965*, and *SAN A 3695*) and in Sarawak, from Bintulu and Kuching districts (e.g., *S 15838* and the type). Also occurring in Brunei (e.g., *FMS 30376* and *FMS 48217*).

Ecology. In lowland mixed dipterocarp forest, at altitudes to 200 m.

Incompletely known species

Aquilaria sp. 1.

Treelet to 2.5 m tall, to 6 cm diameter. **Bark** smooth, greyish green; inner bark green. **Twigs** slender, densely tomentose when young, becoming glabrous and rugose when older. **Leaves** chartaceous to subcoriaceous, glabrous and somewhat shiny above, dull greyish brown and pubescent below; blade oblong-oblanceolate, 12–19.5 × 3–7.5 cm, base obtuse, apex acuminate, acumen to 1.5 cm long; midrib channelled above, raised and pubescent below; lateral veins 16–20 pairs, often branched, flat above, raised below; intercostal venation densely scalariform, obscure above, distinct below; petiole *c.* 0.5 cm long, glabrous. **Inflorescences** (young) axillary or supra-axillary simple umbels, bearing 1–3 young flowers; peduncles 3–5 mm long. **Flowers** (mature) unknown. **Fruits** ovoid-obovoid, occasionally subglobose, 1.2–2 × 1.5–1.9 cm, with longitudinal lines and slightly constricted in the middle; beak 5–7 mm long; pericarp woody, glabrous, smooth and shiny inside. **Seeds** 1, 2 or 3 per fruit, ovoid, including beak 8–10 × 1–9 mm; testa blackish, crustaceous, glabrescent; stalk (stipe) elongate, hook-shaped, *c.* 8 mm long, glabrous, blackish.

Vernacular name. Sarawak—*gaharu engkaras* (Malay).

Distribution. So far known only by a single collection (*S 34204*) from Semengoh FR, Kuching district, Sarawak.

Notes. In vegetative characters, this species closely resemble *A. beccariana* but differs by its smaller, ovoid-obovoid to subglobose fruit, 1.2–2 × 1.5–1.9 cm (*vs.* ellipsoid-obovoid, 2–3.5 × 1.5 cm), shorter stalk, 5–7 mm long (*vs.* 10–12 mm long); its seed without bold appendage (*vs.* with bold appendage) but provided with hook-shaped stalk of *c.* 8 mm long (*vs.* with straight stalk, 3–4 mm long). More flowering and fruiting specimens are, however, needed to confirm its taxonomic status.

4. **GONYSTYLUS** Teijsm. & Binn.

(Greek, *goni-* = angled; Latin, *stylus* = style)

ramin (preferred name), *balet* (Punan Tutoh), *dukun* (Bidayuh, Bau)
gaharu melitan (Iban), *melitan* (Iban), *gatal* (Murut), *kaka* (Bidayuh, Padawan)
kayu liah (Kayan), *lamin ngalang* (Kayan)

Bot. Zeit. 20 (1862) 265; Gamble, J. As. Soc. Beng. 75, 2 (1912) 266; Ridley, FMP 1 (1922) 322; Domke, Bibl. Bot. 27, Heft 111 (1934) 35, 103, 116; Airy Shaw *in* Hooker *f.*, Icon. Pl. 35 (1947) *t.* 3474 & 3475, Kew Bull. (1947) 9, Kew Bull. (1950) 138, Kew Bull. (1952) 73, FM 1, 4 (1953) 350, Kew Bull. 17 (1964) 447, FM 1, 6 (1972) 976; Backer & Bakhuizen *f.*, FJ 1 (1964) 401; Whitmore, TFM 2 (1973) 387; Cockburn, TS 1 (1974) 254; Anderson, CLTS (1980) 332; Kessler & Sidiyasa, TBSA-EK (1994) 226; Coode *et al.* (eds.), CLBD (1996) 321; Argent *et al.* (eds.), MNDT-CK (1997) 633. **Synonym:** *Asclerum* Tiegh., Ann. Sc. Nat. Bot. 7 (1893) 245.

Trees; trunk usually without buttresses; bole straight. **Bark** finely to moderately fissured, sometimes smooth; inner bark pink, reddish brown or slightly orange, laminated, cut surface glistening with irritant, protruding silky fibres. **Leaves** *alternate*, chartaceous to thick-coriaceous, glabrous above, sparsely hairy below, *with translucent glandular dots*, *drying brittle*; *lateral veins numerous*, *more or less parallel and straight*, arching and joining near margins to form distinct intramarginal veins; intercostal veins reticulate. **Inflorescences** *terminal or axillay panicles with few to many branches*; main branches few, lateral branches short and consisting of extremely condensed racemes, often reduced to fascicles of flowers, or consisting of dense racemes of more or less unlimited growth; bracts sometimes present at the flower bud stage, usually caducous. **Flowers** long-pedicelled; calyx tube cupular, split to about one-third or one-fourth of its length, *lobes* 5, aestivation *imbricate*, *subvalvate* or rarely equitans, thick, tough, unequal, tomentose outside, densely hispid-setulose inside; *petaloid appendages 8–65*, *not in pairs*, deltoid or subulate, glabrous or hairy, sometimes pustulate, rigid, reddish brown when dry, *attached at the base of the receptacle*; *stamens* 8–65, *free*, mostly arranged in a single whorl, sometimes in two or three whorls, inserted on the receptacle close to the petaloid appendages, filaments short and slender, anthers basifixed, horseshoe-shaped, rarely rounded, rarely bearded; *ovary* superior, sessile, globose to ovoid, densely setulose, *3*(*–5*)*-loculed*, style elongate, filiform, wiry, sinuate-contorted, hairy or glabrous, stigma clavate or capitate; *parastyles absent or 3–7*, *small*, *clavate or geniculate*; ovules solitary in each locule, apical-pendulous. **Fruits** capsules, rounded, *not beaked*, thick-walled, fibrous, woody, 1–3-seeded, dehiscing into 2–5 valves. **Seeds** large, glossy, smooth, with black crustaceous testa, partially enclosed by red aril arising from the funicle, stony when dry, without endosperm.

Distribution. A genus with about 30 species distributed from the Nicobar Is. to Sumatra, Peninsular Malaysia, Borneo, Java, Sulawesi, the Philippines, New Guinea, Solomon Is., and Fiji. In Sabah and Sarawak, the genus is represented by 27 species (26 well-known and 1 incompletely known), mostly occurring in Sarawak.

Ecology. In Sabah and Sarawak, most species of *Gonystylus* are trees of the lowland and hill mixed dipterocarp forest at altitudes to 700 m. A few, e.g., *G. bancanus* and *G. maingayi* are confined to but locally gregarious in freshwater and peat swamp forests at altitudes to 100 m. In these habitats, trees of these two species produce well-developed specialised “breathing” roots known as pneumatophores. *Gonystylus bancanus* is an important component and often the dominant species of the mixed swamp forest. Other species, e.g., *G. affinis*, *G. borneënsis*, *G. micranthus*, *G. velutinus*, and *G. xylocarpus* occasionally also occur in *kerangas* forest at altitudes to 500 m. *Gonystylus nervosus* is so far the only species recorded from limestone hill forest, whereas a few species, e.g., *G. brunnescens*, *G. lucidulus*, *G. macrophyllus*, and *G. pendulus* are also known from lower montane forest, at altitudes to 1700 m.

The small but aggregated (in various types of inflorescence) flowers of most species are whitish creamy in colour and often sweet-scented at anthesis. Pollination is most probably affected by insects. The fruits, which are capsules, split into 2–5 valves at maturity exposing the arillate seeds. Frugivorous birds and arboreous small mammals are the most likely agents of seed dispersal.

Uses. Several species of *Gonystylus* occurring in Sabah and Sarawak, e.g., *G. affinis*, *G. bancanus*, *G. borneënsis*, *G. consanguineus*, *G. forbesii*, *G. macrophyllus*, *G. maingayi*, *G. velutinus*, and *G. xylocarpus* reach timber size, *i.e.*, to 50 m tall and 100 cm diameter. The timbers are traded as *ramin*, and that of *G. bancanus* constitute the major source. The whitish, light-weight *ramin* timber is highly prized and popular as a decorative cabinet wood. The timber is also widely used in the manufacture of furniture and various items of interior decoration such as wall-panelling, light flooring, turnery, venetion blind slats, picture frames, drawing boards, and a few others. In construction industry, the timber is commonly used for making planks, door and window frames, mouldings, skirtings, ceilings, partitionings, and others. *Ramin* timber is also highly suitable for veneer, plywood, block-board, and particle-board manufacture. The resin-inpregnated heartwood of *G. bancanus* and *G. macrophyllus* is occasionally collected and traded as *gaharu*, similar to that obtained from *Aquilaria malaccensis.* Pounded fruit of *G. keithii* is used as fish poison. (*cf.* PROSEA 5, 1 (1993) 221, for further information).

Key to *Gonystylus* species

1. Leaves larger, 25–50 × 6–15 cm; lateral veins (15–)25–40(–50) pairs……………………2
   Leaves smaller, (5–)8–15(–29) × (2–)4–8(–10) cm; lateral veins (6–)10–20(–30) pairs…..8

2. Leaves bullate……………………………………………………………………………3
   Leaves not bullate…………………………………………………………………………4

3. Leaves larger, 40–50 × 7–11 cm; lateral veins 40–50 pairs; base attenuate, margin strongly revolute; petiole 1.7–1.8 cm long…………………………………………**2. G. areolatus**
   Leaves smaller, 25–32 × 6–8 cm; lateral veins 25–44 pairs; base cuneate, margin slightly revolute; petiole 1–1.5 cm long…………………………………………...**19. G. nervosus**

4. Leaves glabrous on both surfaces, stiff thick-coriaceous; midrib deeply, narrowly impressed above; margin strongly revolute; petiole 3–4 cm long. Fruits ellipsoid, *c.* 6.5 × 5.5 cm, 4-valved, obtusely 4-ridged, verrucose, puberulous………………**20. G. nobilis**
   Not with the above combination of characters……………………………………………5

5. Leaves densely, finely golden-brown velutinous below; midrib narrowly channelled above. Petaloid appendages 40–45; stamens *c.* 55; parastyles absent...**23. G. spectabilis**
   Leaves glabrous on both surfaces or sparsely pilose or tomentose below; midrib flat to prominent above. Petaloid appendages 28–34; stamens 36–51; parastyles 4–6, clavate.6

6. Leaf margin strongly revolute; petiole 0.9–1.5 cm long. Petaloid appendages 34……….
   ……………………………………………………………………………**10. G. costalis**
   Leaf margin slightly or not revolute; petiole 1.8–3 cm long. Petaloid appendages 28–32
   ………………………………………………………………………………………………7

7. Twigs glabrous. Leaf base cordate; margin not revolute; lateral veins 28–30 pairs; petiole 1.8–2.1 cm long. Inflorescences condensed, to 2.5 cm long; petaloid appendages 32, glabrous; stamens *c.* 36 in one whorl…………………………..**7. G. calophylloides**
Twigs tomentellose. Leaf base narrowly attenuate; margin slightly revolute; lateral veins 20–25 pairs; petiole 2–3 cm long. Inflorescences robust, 15–21 cm long; petaloid appendages *c.* 28, sparsely setulose; stamens *c.* 51 in two whorls……..…**12. G. eximius**

8. Leaves thick-coriaceous and often stiff…………………………………………..…9
Leaves chartaceous to coriaceous……………………………………………..…12

9. Leaf margin slightly revolute. Petaloid appendages 12–16; stamens to 14; parastyles absent. Fruits ellipsoid with a short beak…………………………..….**3. G. augescens**
Leaf margin strongly revolute. Petaloid appendages 20–40; stamens 15–25. Fruit subglobose, globose or ovoid-globose, without a beak……………………………..…10

10. Leaves larger, 14–26 × 5–10 cm, glabrous on both surfaces. Petaloid appendages densely setulose. Fruits ovoid-globose, 3.5–5 cm diameter……………………..….**6. G. brunnescens**
Leaves smaller, 4–17 × 2–9 cm, persistently or sparsely hairy at least on the midrib below. Petaloid appendages sparsely setulose or glabrous. Fruits subglobose or globose, 3–7.5 cm diameter………………………………………………………………………………11

11. Petaloid appendages *c.* 20; stamens *c.* 15; parastyles absent. Fruits 3–3.5 cm diameter… ……………………………………………………………………..…**4. G. bancanus**
Petaloid appendages 30–40; stamens *c.* 25; parastyles 4–5. Fruit 5.5–7.5 cm diameter… …………………………………………………………………..….**26. G. xylocarpus**

12. Twigs variously hairy……………………………………………………………..…13
Twigs glabrous…………………………………………………………………………15

13. Leaves larger, 10–21 × 4–10 cm; midrib flat above; petiole 0.7–1.3 cm long. Inflorescences condensed, 1–1.3 cm long; stamens *c.* 37 in 3 whorls...**9. G. consanguineus**
Leaves smaller, 8–13 × 2–6 cm; midrib narrowly channelled above; petiole 0.5–1 cm long. Inflorescences, 2–4-branched, 3–14 cm long; stamens 8–23 in one or two whorls...14

14. Lower leaf surface tomentose; petiole 0.5–0.6 cm long. Calyx lobes ovate, sericeous outside; petaloid appendages 20–30, sparsely setulose; stamens *c.* 23 in two whorls; parastyles *c.* 3, clavate………………………………………………..…**22. G. pendulus**
Lower leaf surface velutinous; petiole 0.5–1 cm long. Calyx lobes deltoid, velutinous, strongly recurved at anthesis; petaloid appendages *c.* 8, glabrous; stamens *c.* 8 in one whorl; parastyles absent…………………………………………..…**25. G. velutinus**

15. Leaves sparsely tomentose below……………………………………………..…16
Leaves glabrous on both surfaces or occasionally sparsely puberulous on the midrib below……………………………………………………………………………………18

16. Petiole 0.8–1 cm long. Inflorescences few-branched, 7–10 cm long; petaloid appendages *c.* 20, densely setulose; stamens *c.* 20 in one whorl……..….**21. G. othmanii**
Petiole 1–1.5 cm long. Inflorescences robust, many-branched, 7–20 cm long; petaloid appendages 24–30, glabrous; stamens 19–38 in one or two whorls…………………...17

17. Leaves larger, 15–22 × 5–8 cm; lateral veins 19–21 pairs; base acute. Petaloid appendages *c.* 30; stamens *c.* 38, in two whorls; parastyles absent……………………**5. G. borneënsis**
Leaves smaller, 12–16 × 5–6.5 cm; base cuneate to obtuse; lateral veins 18–19 pairs. Petaloid appendages *c.* 24; stamens 19–21, in one whorl; parastyles 4, globose…………… ...……………………………………………………………..…**1. G. affinis** (in part)

18. Petiole shorter, 0.7–1 cm long……………………………………………………………19
Petiole longer, 0.9–2.6 cm long………………………………………………………….…20

19. Leaves larger, 16–24 × 5–8 cm; base obtuse; midrib flat above. Inflorescences 4–7 cm long; petaloid appendages *c.* 23, sparsely setulose; stamens *c.* 28; parastyles densely villose…………………………………………………………………..…**8. G. calophyllus**
Leaves smaller, 7–15 × 3–6 cm; base cuneate or rounded; midrib narrowly channelled above. Inflorescences 10–15 cm; petaloid appendages *c.* 7, glabrous; stamens *c.* 6; parastyles glabrous……………………………………………………**18. G. micranthus**

20. Leaf margin not revolute……………………………………………………………………21
Leaf margin slightly to strongly revolute…………………………………………………22

21. Leaves smaller, 5–12 × 2–5 cm, chartaceous to thin-coriaceous; petiole 0.9–1.4 cm long. Petaloid appendages *c.* 10; stamens *c.* 10. Fruits ellipsoid-globose, 2.8–4 cm long, glabrous……………………………………………………………………..…**13. G. forbesii**
Leaves larger, 10–20 × 4–8 cm, coriaceous; petiole 1.3–1.8 cm long. Petaloid appendages *c.* 16; stamens *c.* 18. Fruits ovoid, *c.* 3.5 × 1.7 cm, stellate pubescent….…**15. G. lucidulus**

22. Leaf margin strongly revolute; petiole 2–2.6 cm long. Inflorescences 18–30 cm long... …………………………………………………………………………….…**17. G. maingayi**
Leaf margin only slightly revolute; petiole 0.4–2 cm long. Inflorescences 4–20 cm long ……………………………………………………………………………………………23

23. Midrib raised and prominent above; petiole conspicuously channelled above. Calyx lobes narrowly deltoid-lanceolate, 6–7 × 1.5–2 mm; petaloid appendages to 19………….. …………………………………………………………………….…**24. G. stenosepalus**
Midrib narrowly or deeply channelled above; petiole terete, flat or finely channelled above. Calyx lobes ovate, lanceolate, ovate-oblong, ovate-deltoid or deltoid, 4–8 × 2.5–5 mm; petaloid appendages 20–40…………………………………………………….…24

24. Midrib deeply channelled above; lateral veins obscure above, prominulous below; petiole finely channelled on the adaxial side. Flower buds 7.5–8 × 5.5–6 mm…………... ……………………………………………………………………….…**16. G. macrophyllus**
Midrib narrowly channelled above; lateral veins obscure above and prominent below or prominulous on both surfaces or prominent on both surfaces; petiole terete or flat on the adaxial side. Flower buds 3–6 × 3–7 mm……………………………………….…25

25. Leaves smaller, 12–16 × 5–6.5 cm; lateral veins 18–19 pairs, obscure above, prominent below; petiole tomentose. Petaloid appendages glabrous; parastyles 4, densely velutinous ……………………………………………………………………**1. G. affinis** (in part)
Leaves larger, 13–24 × 4–9 cm; lateral veins 18–23 pairs, prominulous to prominent on both surfaces; petiole glabrous. Petaloid appendages sparsely setulose; parastyles 6 or absent, glabrous……………………………………………………………………….…26

26. Leaf base cuneate; apex caudate; lateral veins prominulous on both surfaces. Petaloid appendages *c.* 26; parastyles 6, glabrous……………………………..…**11. G. decipiens**
Leaf base broadly cuneate or rounded; lateral veins prominent on both surfaces. Petaloid appendages *c.* 20; parastyles absent………………………………**14. G. keithii**

1. **Gonystylus affinis** Radlk.

(Latin, *affinis* = allied to; resembling another species)

Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 16 (1887) 329; Merrill, EB (1921) 371; Masamune, EPB (1942) 446; Airy Shaw *op. cit.* (1953) 357; Anderson *op. cit.* 332; Whitmore *op. cit.* 388; Turner, Gard. Bull. Sing. 47 (1995) 485; Coode *et al.* (eds.) *op. cit.* 321; Argent *et al.* (eds.) *op. cit.* 634. **Type:** *Beccari PB 1209*, 'Borneo' (holotype M; isotype L, fragment). **Synonym** (homotypic)**:** *Gonystylus beccarianus* Tiegh., *op. cit*. 245.

Tree 20–50 m tall, 25–80 cm diameter; bole straight, without buttresses, slightly fluted at base. **Bark** reddish brown, laminated, finely fissured. **Twigs** terete, *glabrous*, dark brown. **Leaves** *chartaceous to coriaceous*, *glabrous on both surfaces or sparsely tomentellous below*, on drying greyish brown above, dull brown or greenish brown below; *blade* oblong to elliptic, sometimes ovate to broadly ovate, *12–16 × 5–6.5 cm*, *base cuneate to obtuse*, *margin slightly revolute*, apex caudate-acuminate; *midrib narrowly channelled above*; *lateral veins 18–19 pairs*, usually rather straight and parallel, *obscure above*, *prominent below*; intercostal venation reticulate; *petiole to 1.5 cm long*, *moderately tomentose*, *terete*, rugose or ribbed, drying reddish brown. **Inflorescences** *robust panicles*, sparsely to densely tomentose, *7–17 cm long*, *many-branched*, side branches nodulose, each bearing 4–6 clusters of flowers, each cluster with 2–5 flowers; bracts absent. **Flowers:** pedicels 0.7–1 cm long, tomentose; buds subglobose, 3–6 × 4–7 mm, at anthesis 6–7 × 6–8 mm; *calyx lobes lanceolate-deltoid*, *4–6 × 4–5 mm*, tomentose outside; *petaloid appendages c. 24*, linear-subulate, 2.4–3 × 0.2–0.5 mm, apex acuminate, curled towards the ovary, pustulate, *glabrous*; *stamens 19–21*, *in a single whorl*, 1.5–2.5 mm long, filaments 1–1.5 mm long, anthers 0.5–1 × 5 mm; ovary ovoid, subglobose, densely velutinous, 3-loculed, style elongate, filiform, to 6 mm long, glabrous, stigma clavate; *parastyles 4*, very small, *globose*, *densely velutinous*. **Fruits** (immature) ovoid-globose, 3.5–5 cm across, 3-valved, warty, reddish brown.

Vernacular name. Sarawak—*ramin bukit* (Malay).

Distribution. Peninsular Malaysia and Borneo.

Ecology. Primary lowland mixed dipterocarp and *kerangas* forests on well-drained sandy clay soils, at altitudes to 300 m.

Uses. The wood is an important source of *ramin* timber in Sarawak.

Notes. Two varieties, *viz*. var. *affinis* and var. *elegans*, are recognised.

Key to varieties

Leaves tomentellous below; petiole shorter than 1 cm long, rugose. Inflorescences densely tomentose…………………………………………………………………………………….

var. **affinis**
Peninsular Malaysia and Borneo. In Borneo, known in Sabah from Kota Belud, Labuk Sugut and Sandakan districts (e.g., *SAN 15372*, *SAN 21729* and *SAN 99853*) and in Sarawak from Kapit, Limbang and Kuching districts (e.g., *S 23949*, *S 37738*, *S 66099*, and *S 68712*). Also occurring in Brunei (e.g., *BRUN 5653*).

Leaves glabrous below; petiole 1.2–1.5 cm long, ribbed. Inflorescences sparsely tomentose……
var. **elegans** Airy Shaw
(Latin, *elegans* = beautiful)
Kew Bull. 28 (1973) 267. Type: *Galau S 14968*, Borneo, Sarawak, Semengoh FR (holotype K; isotypes L, SAR).
Endemic in Borneo; known in Sabah from Labuk Sugut and Sipitang districts (e.g., *SAN 16794*, *SAN 90477*, *SAN 128881*, and *SAN 132745*) and in Sarawak from Kuching, Lundu and Marudi districts (e.g., *S 14968*, *S 15189* and *S 29461*).

2. **Gonystylus areolatus** Domke *ex* Airy Shaw

(Latin, *areolatus* = finely net-like; the intercostal venation of the leaves)

Kew Bull. (1952) 73, *op. cit.* (1953) 353. **Type:** *Jaheri* (*Expedition Nieuwenhuis*) *773*, Borneo, Kalimantan, Samarinda (holotype BO; isotype L).

Small tree, *c.* 10 m tall. **Bark** fuscous, rather smooth, dull greyish brown. **Twigs** robust, 5–10 mm diameter. **Leaves** *strongly bullate*, chartaceous to coriaceous, glabrous above, glabrous to sparsely tomentose below, drying greyish brown above, chestnut-brown below; *blade* oblong, rarely oblanceolate-oblong, *40–50 × 7–11 cm*, *base attenuate*, *margin strongly revolute*, apex long-caudate or cuspidate; midrib narrowly channelled above, sparsely tomentose below; *lateral veins 40–50 pairs*, impressed above, prominent below; intercostal venation distinctly areolate; *petiole 1.7–1.8 cm long*, rugose, glabrous. **Inflorescences** robust panicle with a few branches, 13–15 cm long, tomentose; rachis to 5 mm diameter; bracts absent. **Flower:** pedicels 2.2–2.8 cm long, tomentose; buds subglobose, 8–8.5 × 7–8 mm; calyx lobes deltoid, 8–9 × 3–6 mm, moderately recurved at anthesis, outer surface tomentose, inner surface densely velutinous; petaloid appendages 35–40, in a single whorl, linear to subulate, 2–3 × 0.2 mm, sparsely setulose; stamens 65–80, 2.5–3.5 mm long, glabrous, filaments 1.8–2.5 mm long, anthers 0.5–1.1 × 0.5 mm; ovary 5–6-loculed, ovoid, densely setulose, style robust, *c.* 5 mm long, villous, stigma capitate; parastyles 4–7, clavate, 1.5–2 mm long, glabrous. **Fruits** unknown.

Vernacular names. Sarawak—*ramin*, *ramin bukit* (Malay).

Distribution. Endemic in Borneo; uncommon and known only from Kuching district in Sarawak (e.g., *S 37175*) and from SE Kalimantan (e.g., the type).

Ecology. In primary and secondary mixed dipterocarp forest, on clay or loam soils, at *c.* 50 m altitude.

3. **Gonystylus augescens** Ridl.

(Latin, *augescens* = increasing, elongating; referring to the inflorescence)

Bull. Misc. Inform. Kew (1946) 43; Airy Shaw *in* Hooker *f.*, Icon. Pl. 35 (1947) *t.* 3474, *op. cit.* (1950) 143, *op. cit.* (1953) 353. **Lectotype** (designated here)**:** *Haviland 2078*, Borneo, Sarawak, Kuching (hololectotype K; isolectotypes SAR, SING).

Small tree. **Twigs** terete, dark brown, glabrous. **Leaves** *thick-coriaceous*, chestnut-brown when dry, darker below, glabrous except the midrib below; *blade* broadly elliptic to elliptic oblong, *16–29* × *8–14 cm*, base rounded to subcordate, rarely broadly cuneate, *margin slightly revolute*, apex rounded and shortly cuspidate-acuminate; *midrib narrowly channelled above*, raised below; *lateral veins 18–22 pairs*, prominent on both surfaces; intercostal venation reticulate; petiole 1–1.5 cm long, 3–4 mm diameter, rugose, glabrous. **Inflorescences** 9–18 cm long, 2–3-branched, initially densely ochreous-tomentellous, glabrescent; rachis marked with dense, regular, spiral rows of scars of fallen flowers and bracts; bracts ovate-oblong, cucullate, 4–7 × 2–2.5 mm, subsericeous, caducous. **Flowers:** pedicels 0.5–1.3 cm long; buds subglobose, 3–5 × 3.5–4 mm, tomentose; calyx lobes ovate-deltoid, 3–5 × 2–3 mm, densely fulvous-sericeous; *petaloid appendages 12–16*, subulate, 2.5–3 mm long, densely setulose inside, sparsely setulose or subglabrous outside; *stamens c. 14*, 1.6–2 mm long, in a single whorl, filaments *c.* 1 mm long, anthers 0.5–1 mm long, glabrous; ovary ovoid, *c.* 2.2 mm long, densely velutinous, 3–5-loculed, style filiform, villous, stigma clavate; *parastyles absent*. **Fruits** *ellipsoid with a short beak*, 3–5 × 2–2.5 cm, 3-valved, 6-ribbed, glabrous, dark brown when dry. **Seeds** compressed ellipsoid, *c.* 2.5 × 0.8 mm.

Vernacular name. Sarawak—*ramin* (Malay).

Distribution. Endemic in Borneo. Rather rare, known in Sarawak only from Kuching and Lundu districts (e.g., *Haviland 488*, *S 14466* and *S 15524*).

Ecology. In lowland mixed dipterocarp forest, at low altitudes.

Notes. This species is morphologically closely related to *G. lucidulus* in its reproductive characters, *i.e.*, the inflorescence-type and floral parts, but differs by its shorter petioles and the colour of drying leaves.

4. **Gonystylus bancanus** (Miq.) Kurz

(of Bangka Is., Sumatra)

Nat. Tijds. Ned. Ind. 27 (1864) 171, 240; Airy Shaw, Kew Bull. (1947) 9, *op. cit.* (1953) 361; Whitmore *op. cit.* 388; Cockburn *op. cit.* 256; Anderson *op. cit.* 332; Turner *op. cit.* 485; Coode *et al.* (eds.) *op. cit.* 321; Argent *et al.* (eds.) *op. cit.* 634. **Basionym:** *Aquilaria ?bancana* Miq., Fl. Ind. Bat., Suppl. (1861) 355. **Type:** *Teijsmann HB 3494*, Sumatra, Bangka Is. (holotype BO; isotype U). **Synonyms:** *Gonystylus miquelianus* Teijsm. & Binn. *op. cit.* 265; *G. hackenbergii* Diels, Bot. Jahrb. 60 (1926) 310.

Tree 25–50 m tall, 30–100 cm diameter; bole straight, without buttresses. **Bark** slightly fissured, dark or greyish brown; inner bark reddish brown, 3–5 cm thick, fibrous. **Sapwood** white to pale yellowish cream. **Twigs** glabrous, dark greyish brown. **Leaves** *thick-coriaceous*, glabrous above, *persistently hairy on the midrib below*, drying characteristically reddish brown below, often folded; *blade* elliptic, oblong-oblanceolate or obovate, *4–15* × *2–7 cm*, base broadly rounded to obtuse, *margin strongly revolute*, apex rounded-acuminate, acumen to 2 cm long; midrib narrowly channelled above, rounded and prominent below; *lateral veins 10–18 pairs*, closely arranged, distinct above, less so below; intercostal venation visible above, faint below; petiole 0.7–1.8 cm long, channelled above, glabrous, rugose. **Inflorescences** 8–15 cm long, densely tomentose; bracts absent. **Flowers** in clusters of 2–5; pedicels 1–1.8 cm long, tomentose; buds subglobose, 4–5 mm diameter; calyx lobes deltoid, 3–4 mm long, tomentose outside, densely velutinous inside, ciliate at the margin; *petaloid appendages c. 20*, in a single whorl, subulate, 1.5–3 × 0.5–1 mm, *glabrous*; *stamens c. 15*, 1.5–3 mm long, in a single whorl, filaments 1–2 mm long, anthers 0.5–1 × 0.5 mm, glabrous; ovary ovoid-globose, *c.* 2 × 2 mm, densely setulose, 3-loculed, style filiform, glabrous, stigma clavate; *parastyles absent*. **Fruits** *globose or subglobose*, *3–3.5 cm diameter*, 3–4-valved, *without a beak*; pericarp surface minutely dotted, rough, fibrous, brown. **Seeds** ovoid or ellipsoid, 2–2.8 × 1.6 cm; testa dark brown, glossy, crustaceous; without endosperm.

Vernacular names. Sabah—*bidaru* (Kedayan), *ramin* (Malay). Sarawak—*lunak* (Melanau Oya), *ramin*, *ramin telur* (Malay).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known in Sabah from Beaufort, Papar, Ranau, Sipitang, and Tawau districts (e.g., *SAN 34692*, *SAN 56672*, *SAN 93904*, *SAN 132120*, and *SAN A 1719*) and in Sarawak from Betong, Bintulu, Kuching, Miri, Mukah, Sibu, Simunjan, and Sri Aman districts (e.g., *S 1733*, *S 8005*, *S 10001*, and *S 77006*). Also occurring in Brunei (e.g., *FMS 28674* and *FMS 36985*) and in Kalimantan (e.g., *bb. 16645* and *bb. 32396*).

Ecology. Locally common in mixed swamp and peat swamp forests (particularly common in the *Gonystylus bancanus-Dactylocladus-Neoscortechinia* association of peat swamp forest in Brunei and Sarawak), at altitudes to 100 m. In water-logged habitat, the species develops specialised knee-roots (pneumatophores).

Uses. The most important source of *ramin* timber. The timber has been extensively exploited in Malaysia (especially in Sarawak), and is highly valued for planks, furniture, panelling, mouldings of all kinds, and verneer.

5. **Gonystylus borneënsis** (Tiegh.) Gilg

(of Borneo)

In Engler & Prantl, Nat. Pflanzenfam. Nachtr. 1 (1897) 232; Merrill *op. cit.* (1921) 372; Masamune *op. cit.* 447; Airy Shaw, Kew Bull. (1947) 9, *op. cit.* (1953) 355; Cockburn *op. cit.* 255; Anderson *op. cit.* 333; Coode *et al.* (eds.) *l.c.* 321; Argent *et al.* (eds.) *op. cit.* 634. **Basionym:** *Asclerum borneense* Tiegh., *op. cit.* 247. **Type:** *Beccari P.B. 1589*, Borneo, Sarawak, Mt. Matang (isotype L, fragment). **Synonym:** *Gonystylus bancanus auct. non* (Miq.) Kurz: Merrill, PEB (1929) 184, Masamune *op. cit.* 446.

Tree 24–35 m tall, to 60 cm diameter; bole straight, slightly fluted at base, with low buttresses. **Bark** greyish brown, finely irregularly fissured; inner bark 5 mm thick, orange-yellow to reddish brown. **Sapwood** whitish or cream. **Twigs** rough, *glabrous*, blackish to reddish brown. **Leaves** *chartaceous to coriaceous*, glabrous above, *sparsely tomentose below*, drying greyish brown on both surfaces; *blade* oblong or sometimes narrowly elliptic, *15–22 × 5–8 cm*, *base acute*, margin slightly revolute, apex acuminate or sometimes caudate; midrib narrowly channelled above; *lateral veins 19–21 pairs*, prominent on both surfaces; intercostal venation reticulate; *petiole 1–1.2 cm long*, rugose, sparsely tomentose. **Inflorescences** *15–20 cm long*, pendulous, *many-branched*, each branch bearing 5 or more clusters of flowers, each cluster with 3–5 flowers, appressed tomentellous; bracts absent. **Flowers:** pedicels 2.6–3 cm long, sericeous; buds subglobose, 7.5–8 × 7–7.5 mm, tomentose; calyx lobes deltoid, 7.5–9 × 2.5–5.5 mm, tomentose outside, densely velutinous inside; *petaloid appendages c. 30*, in a single whorl, linear-subulate, 4.5–5.4 × 5 mm, apex rarely incised, *glabrous*; *stamens c. 38*, *c.* 3 mm long, *in two whorls*, filaments *c.* 1.5 mm long, anthers *c.* 1.5 mm long, glabrous; ovary obovoid, densely setulose, 5-loculed, style filiform, *c.* 9.5 mm long, glabrous, stigma clavate; *parastyles absent*. **Fruits** round, 5–7 cm diameter, brown, rough.

Vernacular name. Sarawak—*ramin* (Malay).

Distribution. Endemic in Borneo. In Sabah, known from Kinabatangan, Ranau, Sipitang, and Tawau districts (e.g., *SAN 16614*, *SAN 36458* and *SAN 94043*) and in Sarawak, from Kapit, Kuching, Lundu, Marudi, Miri, Simunjan, Sri Aman, and Tatau districts (e.g., *S 23092*, *S 35686*, *S 37207*, *S 41855*, and *S 59971*). Also occurring in Brunei (e.g., *BRUN 316*, *Forman LLF 1078* and *Kirkup DK 356*) and in Kalimantan.

Ecology. In mixed dipterocarp and *kerangas* forests on yellow sandy clay and sandy soils, at altitudes to 500 m.

6. **Gonystylus brunnescens** Airy Shaw

(Latin, *brunnescens* = brownish; the drying leaves)

Kew Bull. (1950) 138, *op. cit.* (1953) 138; Whitmore *op. cit.* (1973) 388; Anderson *op. cit.* 333; Kessler & Sidiyasa *op. cit.* 226; Turner *op. cit.* 485; Argent *et al.* (eds.) *op. cit.* 635. **Type:** *Budding bb. 29629*, Borneo, Kalimantan, Melawai (holotype BO). **Synonym:** *Gonystylus bancanus auct. non* (Miq.) Kurz: Heine *in* Fedde, Rep. 54 (1951) 239.

Tree 20–40 m tall, 30–100 cm diameter; buttresses to 0.3 m tall. **Bark** reddish to dark brown, more or less smooth; inner bark pinkish red, fibrous. **Sapwood** yellowish white. **Twigs** dark brown, glabrous. **Leaves** *thick-coriaceous*, *glabrous on both surfaces*, drying dark brown on both surfaces; *blade* elliptic to oblong, *14–26 × 5–10 cm*, base obtuse, *margin strongly revolute*, apex caudate; midrib narrowly channelled above, glabrous; *lateral veins 15–25 pairs*, distinct on both surfaces, intramarginal veins 1–2 mm from the margin; intercostal venation visible on both surfaces; petiole 1–1.5 cm long, glabrous, ribbed, reddish brown. **Inflorescences** 6–22 cm long, sparsely tomentose; bracts absent. **Flowers:** pedicels 1.5–1.8 cm long, tomentose; buds subglobose, 5–6 × 4–6 mm; calyx lobes deltoid, 5–5.2 × 2–3.5 mm, densely tomentose outside, densely velutinous inside; *petaloid appendages c. 20*, in a single whorl, linear-subulate, 3–3.5 × *c.* 0.5 mm, *densely setulose*; *stamens c. 18*, 3–3.5 mm long, in a single whorl, filaments 1.5–2 mm long, anthers *c.* 1.5 × 0.5 mm, glabrous; ovary ovoid, 3-loculed, densely setulose; style filiform, *c.* 3 mm long, glabrous, stigma clavate; parastyles 5–6, globose, tomentose. **Fruits** *ovoid-globose*, *without a beak*, *3.5–5 cm diameter*, 3-valved, verrucose, brown.

Vernacular names. Sabah—*nasi-nasi pakir* (Malay). Sarawak—*ramin* (Malay).

Distribution. Peninsular Malaysia and Borneo. In Borneo, recorded in Sabah from Mt. Kinabalu (e.g., *Clemens 50705* and *SFN 26391*) and in Sarawak from Bau, Belaga, Kapit, and Samarahan districts (e.g., *S 17028*, *S 19099*, *S 29033*, *S 41322*, and *S 43651*). Also occurring in Brunei (e.g., *FMS 34575*) and in Kalimantan (e.g., *bb. 8311*, *bb. 31633* and *Church et al. 166*).

Ecology. In mixed dipterocarp and lower montane forests on clay and sandy soils, at 40–1500 m altitude.

7. **Gonystylus calophylloides** Airy Shaw

(Latin, resembling *G. calophyllus*)

Kew Bull. 17 (1964) 448, *op. cit.* (1972) 979; Anderson *op. cit.* 333; Coode *et al.* (eds.) *op. cit.* 321. **Type:** *Anderson S 4266*, Borneo, Sarawak, Marudi district, Ulu Sg. Melinau (holotype SAR; isotypes K, L, SING).

Small tree, 6–10 m tall, 10–25 cm diameter. **Twigs** rugose, *glabrous*, dark brown, sometimes lenticellate. **Leaves** *chartaceous to coriaceous*, drying yellowish brown to greyish brown on both surfaces, *glabrous on both surfaces or sparsely tomentose below*; *blade* oblong to oblanceolate-oblong, *30–40 × 8–12 cm*, *base cordate*, *margin not revolute*, apex rounded and abruptly shortly caudate; *midrib flat or slightly prominulous above*, prominent below; *lateral veins 28–30 pairs*; intercostal venation reticulate; *petiole 1.8–2.1 cm long*, glabrous, rugose, dark brown. **Inflorescences** *condensed*, *to 2.5 cm long*, few-flowered, sericeous; bracts absent. **Flowers:** pedicels slender, 2.8–3.2 cm long, yellowish brown sericeous; buds globose, 7–8 mm diameter, tomentose; calyx lobes broadly deltoid to lanceolate, 7–10 × 3–6 mm, sparsely tomentose outside, densely velutinous inside; *petaloid appendages c. 32*, in two whorls, linear-subulate, 4.5–5 × 1 mm, *glabrous*; *stamens 36*, 2.5–3 mm long, *in a single whorl*, filaments 1–1.5 mm long, anthers 1.5 mm long, glabrous; ovary ovoid, 2–3 mm long, 5-loculed, densely setulose, styles elongate, filiform, densely villous, stigma clavate; *parastyles 5*, 1–1.5 mm long, *clavate*, rather flat, densely villous. **Fruits** *globose*, *c. 3.5 cm diameter*, *5-valved*, verrucose, puberulous, substended by 5 persistent calyx lobes borne on striate stalks of *c.* 2.5 cm long. **Seeds** solitary, large, glossy, brown, stony when dry.

Vernacular name. Sarawak—*ramin* (Malay).

Distribution. Endemic in Borneo. Known in Sarawak from Belaga, Bintulu, Marudi, and Tatau districts (e.g., *S 21814*, *S 43706*, *S 51410*, and the type). Also occurring in Brunei (e.g., *Coode MC 7242*, *Dransfield JD 6651*, *Forman LLF 927*, *Wong WKM 1151*, and *Wong WKM 2082*).

Ecology. In mixed dipterocarp forest, on rocky boulder-strewn gorge and basalt hillsides, at altitudes to 200 m.

8. **Gonystylus calophyllus** Gilg

(Greek, *calo-* = beautiful, *phullon* = leaf; with beautiful leaves)

In Engler & Prantl Nat. Pflanzenfam. Nachtr. 1 (1897) 232; Merrill *op. cit.* (1921) 372; Masamune *op. cit.* 447; Airy Shaw *op. cit.* (1953) 354; Anderson *op. cit.* 333. **Type:** *Haviland 998*, Borneo, Sarawak, Kuching (holotype K).

Small tree. **Twigs** rugose, *glabrous*, dark brown. **Leaves** *chartaceous to coriaceous*, *glabrous*, drying purplish-leaden coloured on both surfaces; *blade* elliptic to oblong, *16–24 × 5–8 cm*, *base obtuse*, margin slightly revolute, apex caudate; *midrib flat above*, glabrous; *lateral veins 28–35 pairs*, very distinct; intercostal venation reticulate; *petiole 0.7–1 cm long*, robust, glabrous, rugose, dark brown. **Inflorescences** *4–7 cm long*, tomentose; bracts absent. **Flowers:** pedicels 1–1.5 cm long, tomentose; buds subglobose, 7–7.5 × 5.5–6 mm, tomentose; calyx lobes narrowly deltoid, 6.5–7 × 1–1.5 mm, tomentose outside, densely velutinous inside; *petaloid appendages c. 23*, in a single whorl, linear-subulate, 4–5 × 0.5 mm, *sparsely setulose*; *stamens c. 28*, in two whorls, 3.4–4 mm long, filaments *c.* 1 mm long, anthers 2.5–3 mm long, glabrous; ovary ovoid, 3–loculed, densely setulose, style solitary, filiform, *c.* 7 mm long, villous, stigma clavate; *parastyles 4–6*, geniculate, *c.* 1 mm long, *densely villose*. **Fruits** unknown.

Vernacular name. Sarawak—*ramin* (Malay).

Distribution. Endemic in Borneo. Uncommon; known only in Sarawak from Bintulu, Kuching, Miri, and Serian districts (e.g., *S 21775*, *S 27583*, *S 68753*, and *S 82579*).

Ecology. In lowland mixed dipterocarp forest on clay and loamy soils.

9. **Gonystylus consanguineus** Airy Shaw

(Latin, *con-* = similar, *sanguinis* = blood; closely allied to *G. affinis* and *G. borneënsis*)

Kew Bull. 17 (1964) 454, *op. cit.* (1972) 979; Cockburn *op. cit.* 255; Kessler & Sidiyasa *op. cit.* 227; Argent *et al.* (eds.) *op. cit.* 635. **Type:** *Meijer SAN 21729*, Borneo, Sabah, Sandakan district, Sepilok FR (holotype K; isotype L).

Tree 20–40 m tall, 30–80 cm diameter; buttresses to 2 m tall. **Bark** fissured, dark brown. **Twigs** somewhat slender, *short fulvo-tomentellous*, glabrescent, dark brown. **Leaves** *chartaceous to coriaceous*, moderately punctate, sparsely tomentose, drying greyish green above, yellowish brown below; *blade* elliptic to oblong, *10–21 × 4–10 cm*, base rounded or obtuse, margin sligtly revolute, apex acuminate or sometimes caudate; *midrib flat above*, rounded and prominent below, sparsely puberulous; *lateral veins 15–25 pairs*, prominulous on both surfaces, intramarginal veins 1–2 mm from the margins; intercostal venation visible on both surfaces; *petiole 0.7–1.3 cm long*, sparsely tomentose. **Inflorescences** *condensed*, *1–1.3 cm long*, sparsely hairy; bracts absent. **Flowers:** pedicels 4–5 mm long, tomentose; buds subglobose, 5–6 × 4–6 mm; calyx lobes deltoid, 4–5 × 4 mm, tomentose; petaloid appendages *c.* 30, *c.* 2 × 0.5 mm, glabrous; *stamens c. 37*, 1.5–2 mm long, *in 3 whorls*, filaments *c.* 1 mm long, anthers 0.5–1 × 0.5 mm, glabrous; ovary ovoid, 1–1.5 mm long, 3-loculed, densely setulose, styles short, contorted, glabrous, stigma small, clavate; parastyles absent. **Fruits** (immature) ovoid-globose to ellipsoid, 2–3 × 1.5–1.8 cm; stalk *c.* 2.2 cm long; pericarp verrucose.

Vernacular name. Sabah—*ramin* (Malay).

Distribution. Endemic in Borneo. In Sabah, recorded from Kinabatangan, Kuala Penyu, Labuk Sugut, Penampang, Sandakan, Tawau, and Tenom districts (e.g., *SAN 23578*, *SAN 92055*, *SAN 103042*, and *SAN 121244*) and in Sarawak, from Miri district (e.g., *S 15827*, *S 37003* and *S 43162*). Also occurring in W and E Kalimantan (e.g., *Kostermans 5286* and *Kostermans 13901*).

Ecology. In primary and secondary mixed dipterocarp forests, at altitudes to 700 m.

10. **Gonystylus costalis** Airy Shaw

(Latin, *costalis* = relating to the midrib)

Kew Bull. 23 (1969) 269, *op. cit.* (1972) 980; Anderson *op. cit.* 333. **Type:** *Wright S 23989*, Borneo, Sarawak, Kapit district, Bt. Raya (holotype K; isotypes L, SAN).

Small tree, 5–10 m tall, 8–10 cm diameter. **Bark** slightly flaky, greyish brown. **Twigs** 5–8 mm diameter, rugulose-sulcate, greyish brown, appressed greyish brown puberulous, glabrescent. **Leaves** *coriaceous*, *glabrous or sparsely hairy at the base of midrib below*, drying brownish on both surfaces; *blade* oblong-elliptic, *25–45 × 8–14 cm*, base cuneate or sometimes cordate, *margin strongly revolute*, apex subrotundate and shortly apiculate-caudate; *midrib prominent below*, *broadly but shallowly elevated above*; *lateral veins 24–26 pairs*, obscure above, prominent below; intercostal venation reticulate; *petiole 0.9–1.5 cm long*, sparsely short-tomentose, rugose, dark brown. **Inflorescences** robust, to 17 cm long, fulvous-tomentellous; bracts ovate, 4–5 × 2.5–3 mm, tomentose. **Flowers:** pedicels 1.5–2.5 cm long, tomentose; buds subglobose, 7–7.5 × 5.5–6 mm, tomentose; calyx lobes deltoid, 5.5–6 × 5–5.5 mm, tomentose outside, densely velutinous inside; *petaloid appendages c. 34*, in a single whorl, linear-subulate, 2–2.5 × 0.5 mm, glabrous; *stamens c. 37*, 1.5–3 mm long, in a single whorl, filaments 1–1.5 mm long, anthers *c.* 1 × 0.5 mm, glabrous; ovary ovoid, densely setulose, 3-loculed, style filiform, glabrous, stigma clavate; *parastyles 4–6*, 0.5–1 mm long, *clavate*, densely villous. **Fruits** unknown.

Vernacular name. Sarawak—*ramin* (Malay).

Distribution. Endemic in Borneo; known only from Belaga and Kapit districts in Sarawak (e.g., *S 25748*, *S 29185*, *S 29664*, and *S 53427*).

Ecology. In primary mixed dipterocarp forest on clay soil, at 160–700 m altitude.

11. **Gonystylus decipiens** Airy Shaw

(Latin, *decipiens* = deceiving; a species closely resembling another species)

Kew Bull. 17 (1964) 454, *op. cit.* (1972) 980. **Type:** *Jacobs 5456*, Borneo, Sarawak, Belaga district (holotype K).

Tree 25–30 m tall. **Twigs** terete, 3–4 mm diameter, *glabrous*, dark brown. **Leaves** *chartaceous to coriaceous*, *glabrous*, drying greyish brown to slightly greenish on both surfaces; *blade* elliptic, oblong or oblanceolate, *16–21 × 6–8 cm*, *base cuneate*, *margin slightly revolute*, *apex caudate*; *midrib narrowly channelled above*, sparsely puberulous; *lateral veins 19–23 pairs*, *prominulous on both surfaces*; intercostal venation reticulate; *petiole 1.3–1.5 cm long*, *terete*, *glabrous*, rugose, dark brown. **Inflorescences** with many branches, *8–16 cm long*, bearing numerous flowers, tomentose; bracts absent. **Flowers:** pedicles 1–1.5 cm long, tomentose; buds subglobose, 5–6 × 3–4 mm, tomentose; *calyx lobes deltoid*, *5–6 × 2.5–3 mm*, tomentose outside, densely velutinous inside; *petaloid appendages c. 26*, in a single whorl, linear-subulate, 2.5–3 × 0.5 mm, *sparsely setulose*; filaments and anthers of equal length, *c.* 1 mm, glabrous; ovary 3-loculed, densely setulose, style *c.* 6 mm long, filiform, glabrous, stigma clavate; *parastyles 6*, *c.* 0.5 mm long, *glabrous*. **Fruits** unknown.

Vernacular name. Sarawak—*ramin* (Malay).

Distribution. Endemic in Borneo; known only from the type.

Ecology. In primary dipterocarp forest on sandstone substratum, at *c.* 500 m altitude.

12. **Gonystylus eximius** Airy Shaw

(Latin, *eximius* = excellent; inference unknown)

Kew Bull. 28 (1973) 267. **Type:** *Ilias S 28777*, Borneo, Sarawak, Kapit district, Ulu Merit, Sg. Sebatong (holotype K; isotypes L, SAR, SING).

Small tree, to 5 m tall, 10 cm diameter. **Twigs** robust, terete, 6–8 mm diameter, *yellowish brown tomentellous*, glabrescent. **Leaves** *coriaceous*, *sparsely pilose or glabrous above*, *sparsely pilose below*, drying greenish above, chestnut-brown below; *blade* elliptic-oblong or oblanceolate-oblong, *33–48 × 9–15 cm*, *base narrowed*, *abruptly attenuate towards the petiole*, *margin slightly revolute*, apex rotundate and abruptly caudate; *midrib conspicuously raised and glabrous above*, prominent and densely pilose below; *lateral veins 20–25 pairs*, with several shorter parallel veins in between, impressed above, conspicuously raised below, arching and anastomosing near the margin to form intramarginal veins; intercostal venation reticulate, raised; *petiole 2–3 cm long*, 6–8 mm thick, rugose, puberulous. **Inflorescences** terminal, *robust*, *15–21 cm long*, densely reddish brown tomentose; bracts absent. **Flowers:** pedicels robust, 1–2 cm long before anthesis, to 6 cm long at anthesis, densely reddish brown velutinous; buds subglobose, 9–10 × 5.5–6 mm, tomentose; calyx lobes narrowly ovate to lanceolate, 11–16 × 4.5–5 mm, tomentose outside, densely velutinous inside; *petaloid appendages c. 28*, in a single whorl, linear-subulate, 8–9 × 0.5–1 mm, sometimes incised at apex, sparsely pustulate, *sparsely setulose*; *stamens c. 51*, 4–5 mm long, *in two whorls*, filaments *c.* 3 mm long, anthers *c.* 2.5 × 0.5 mm, bearded; ovary ovoid, 5-loculed, setulose, style elongate, villous, stigma clavate; *parastyles 4–5*, *clavate*, 1–1.5 mm long. **Fruits** unknown.

Vernacular name. Sarawak—*ramin* (Malay).

Distribution. Endemic in Borneo; known by two collections from Sg. Sebatong, Ulu Merit, Kapit district in Sarawak (*S 28773* and the type).

Ecology. In primary lowland mixed dipterocarp forest near streams, on sandy and clay soil, at altitudes to 250 m.

Notes. Very similar to *G. costalis* but differs by its prominently veined and thinly pilose lower leaf-surface, the densely tomentellous inflorescences, and the very large flowers borne on elongated pedicels.

13. **Gonystylus forbesii** Gilg Plates 6D–E.

(H.O. Forbes, 1851–1932, Scottish botanist/naturalist)

In Engler & Prantl, Nat. Pflanzenfam. Nachtr. 1 (1897) 232; Merrill *op. cit.* (1921) 372; Masamune *op. cit.* 447; Airy Shaw *op. cit.* (1953) 357; Cockburn *op. cit.* 255; Anderson *op. cit.* 333; Argent *et al.* (eds.) *op. cit.* 635. **Type:** *Forbes 3078*, Sumatra (holotype L). **Synonyms:** *Gonystylus warburgianus* Gilg. *ex* Domke *op. cit.* 5, 8, 33, 146; *G. bancanus auct. non* (Miq.) Kurz: S. Moore, J. Bot. Suppl. 62 (1924) 14.

Tree 30–55 m tall, 40–80 cm diameter; trunk straight, buttresses to 1.7 m tall. **Bark** fissured, flaking off, greyish brown; inner bark pinkish red, fibrous. **Sapwood** pale yellow. **Twigs** *glabrous*, dark brown to blackish. **Leaves** *chartaceous to thin-coriaceous*, shagreen and *glabrous on both surfaces or sparsely puberulous below*, especially on midrib, drying yellowish brown on both surfaces; *blade* elliptic to almost rhomboid, *5–12 × 2–5 cm*, base cuneate, *margin flat*, apex acuminate or rounded-caudate; midrib narrowly channelled or rarely almost flat above; *lateral veins 10–20 pairs*, closely arranged, rather steeply ascending, conspicuous below, less so above, intramarginal veins 0.5–1 mm from the margin; intercostal venation faint on both surfaces; *petiole* slender, *0.9–1.4 cm long*, sparsely tomentose, rugose. **Inflorescences** with many branches, 5–15 cm long, each branch bearing 4–8 clusters of flowers, each cluster with 4–6 flowers, reddish yellow short-hairy; bracts absent. **Flowers:** pedicels slender, to 1 cm long, tomentellous; buds subglobose, 3–3.5 × 2–2.5 mm; calyx lobes ovate-deltoid, 3–5 × 2–3 mm, tomentellous at the edges, strongly recurved at anthesis; *petaloid appendages c. 10*, in a single whorl, subulate, 0.5–1 × 0.5 mm, densely setulose; *stamens c. 10*, 1.5–2 mm long, in a single whorl, filaments and anthers 0.5–1 mm long, anthers glabrous; ovary 3-loculed, densely setulose, style glabrous, stigma clavate; parastyles absent. **Fruits** *ellipsoid-globose*, *2.8–4 cm long*, 3-valved, *glabrous*, verrucose, rugose, dark brown; pericarp fibrous. **Seeds** ellipsoid, *c.* 1.3 cm long, stony; testa smooth, glossy, dark brown, crustaceous.

Vernacular name. Sarawak—*ramin batu* (preferred name).

Distribution. Sumatra and Borneo. In Sabah, known from Beaufort, Keningau, Kinabatangan, Labuk Sugut, Papar, Sandakan, Sipitang, and Tawau districts (e.g., *SAN 15243*, *SAN 30618*, *SAN 65359*, *SAN 79087*, and *SAN 96655*) and in Sarawak, from Kapit, Kuching, Lawas, Lubok Antu, Marudi, Sarikei, Sibu, and Sri Aman districts (e.g., *S 8084*, *S 29075*, *S 33015*, *S 41403*, and *S 68193*). Also occurring in Brunei (e.g., *FMS 34478*) and E Kalimantan (e.g., *bb. 16824*).

Ecology. In primary mixed dipterocarp and lower montane forests, on clay and sandy soils, at altitudes to 1200 m.

Uses. Source of *ramin* timber. However, this species is not as abundant as *G. bancanus*.

14. **Gonystylus keithii** Airy Shaw

(H.G. Keith, former Conservator of Forests at Sandakan, Sabah)

Kew Bull. (1947) 13, *op. cit.* (1953) 356, *op. cit.* (1964) 453; Cockburn *op. cit.* 254; Anderson *op. cit.* 333; Coode *et al.* (eds.) *op. cit.* 321; Argent *et al.* (eds.) *op. cit.* 635. **Lectotype** (designated here)**:** *Puasa BNBFD 1722*, Borneo, Sabah, Sandakan (hololectotype K). **Synonym:** *Gonystylus bancanus auct. non* (Miq) Kurz: Merrill *op. cit.* (1929) 184.

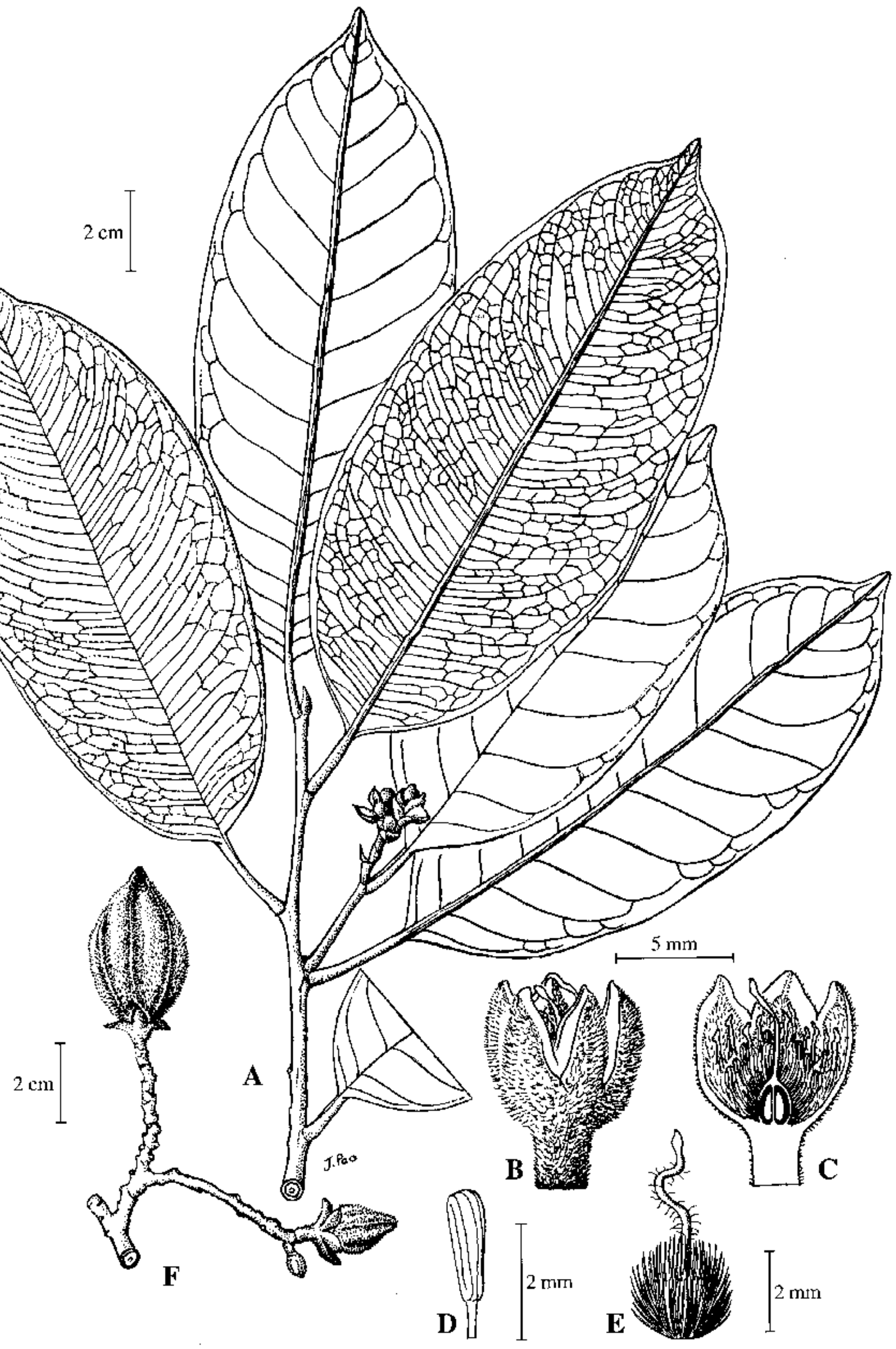

Fig. 4. *Gonystylus lucidulus*. A, flowering leafy twig; B, open flower; C, longitudinal section of open flower; D, stamen; E, gynoecium; F, infructescence. (A–E from *S 40450*, F from *S 3024*.)

Tree to 25 m tall, to 46 cm diameter; trunk straight, without buttresses. **Bark** fissured, smooth to slightly flaky, greyish brown; inner bark pink to dark red. **Sapwood** yellow. **Twigs** blackish grey, *glabrous*. **Leaves** *chartaceous*, *glabrous on both surfaces*, drying discolourous, greyish green above, pinkish brown below; *blade* elliptic-oblong to oblanceolate, *13–24 × 4–9 cm*, *base broadly cuneate to almost rounded*, *margin slightly revolute*, apex acuminate to caudate, acumen to 2 cm long; *midrib narrowly channelled above*; *lateral veins* lax, *18–23 pairs*, with 2–3 shorter veins in between, *prominent on both surfaces*; intercostal venation visible on both surfaces; *petiole 1–2 cm long*, *flat above*, *glabrous*, rugose, dark brown. **Inflorescences** terminal, short-branched, *9–15 cm long*, sparsely to densely grey tomentose, each branch bearing 5–9 clusters of flowers, each cluster with 5–8 flowers; bracts ovate, 2–3 × 1–1.5 mm, tomentose. **Flowers:** pedicels 0.8–2 cm long, densely yellowish brown tomentellous; buds subglobose, 4.5–5 mm diameter; *calyx lobes ovate to ovate-oblong*, *6–8 × 4–5 mm*, densely subsericeous on both sides, sometimes pustulate outside; *petaloid appendages c. 20*, linear-subulate, 2–4 × 0.5 mm, sometimes incised at apex, *sparsely setulose*, with numerous spherical creamy pustules, especially on the upper surface; stamens *c.* 21, 1–1.5 mm long, in a single whorl, filaments *c.* 1 mm long, anthers *c.* 0.5 mm long, glabrous; ovary ovoid, 2–3 mm long, 3-loculed, densely setulose, style filiform, *c.* 4 mm long, glabrous, stigma capitate; *parastyles absent*. **Fruits** rounded or spheroidal, to 6.5 cm diameter, 3–5-valved, brown, verrucate; pericarp fibrous. **Seeds** ellipsoid, stony; testa smooth, glossy, brown, crustaceous; hilum velutinous.

Vernacular names. Sabah—*karai* (Malay), *malindah* (Sungei), *saukau* (Kedayan).

Distribution. Endemic in Borneo. In Sabah, recorded from Beaufort, Keningau, Kinabatangan, Labuk Sugut, Lahad Datu, Pensiangan, Pitas, Ranau, Sandakan, and Tawau districts (e.g., *SAN 16900*, *SAN 25774*, *SAN 36908*, *SAN 83421*, and *SAN 121296*). Also occurring in Brunei (e.g., *BRUN 868*) and in Kalimantan (e.g., *bb. 34791* and *Church & Mahyar 1434*).

Ecology. In primary mixed dipterocarp forest, on sandy soil, at 30–350 m altitude.

Uses. In Sabah, pounded fruit mixed with wood ashes is locally used as fish poison.

15. **Gonystylus lucidulus** Airy Shaw Fig. 4.

(Latin, *lucidulus* = somewhat shining; referring to the upper surface of drying leaves)

Kew Bull. 17 (1964) 447, *op. cit.* (1972) 981; Coode *et al.* (eds.) *op. cit.* 321. **Type:** *Dan S 3024*, Borneo, Sarawak, Miri district, Bt. Lambir (holotype K; isotypes L, SAN).

Tree 27–36 m tall, 30–45 cm diameter; trunk straight, without buttresses. **Bark** finely fissured, flaking to small pieces, soft and fibrous; inner bark soft, pale brown. **Sapwood** hard, pale yellow. **Twigs** terete, 3–5 mm diameter, finely striate, dark brown, *glabrous*. **Leaves** *coriaceous*, *glabrous on both surfaces*, shining above, sparsely puncticulate below, drying greenish above, greyish brown below; *blade* oblong, elliptic-oblong or lanceolate-oblong, *10–20 × 4–8 cm*, base rotundate, rarely cuneate or subcordate, *margin not revolute*, apex narrowly rotunded, abruptly caudate; midrib narrowly channelled above, prominent and glabrous below; *lateral veins 8–16 pairs*, lax, prominulous on both surfaces; intercostal venation reticulate; *petiole* slender, *1.3–1.8 cm long*, 2–3 mm thick, sparsely yellowish brown tomentose, rugose, grooved above. **Inflorescences** 2–4-branched, 3–9 cm long; flowers borne singly and alternately along the branches; rachis thick, knobby, marked with dense, regular, spiral rows of scars of fallen flowers and bracts; bracts numerous, suborbicular, 7–8 mm broad, dorsally keeled, glabrous. **Flowers:** pedicels 0.3–0.4 cm long, tomentose; buds subglobose, 4–5 × 3.5–4 mm, tomentose; calyx lobes deltoid, 4–4.5 mm long, tomentose outside, densely velutinous inside; *petaloid appendages c. 16*, in a single whorl, linear-subulate, 2.5–3 × 0.5 mm, epustulate, densely setulose; *stamens c. 18*, 1.5–2 mm long, in a single whorl, filaments 0.5–1 mm long, anthers 1.5–2 × 0.5 mm, glabrous; ovary ovoid, densely setulose, style filiform, densly villous, stigma clavate; parastyles absent. **Fruits** (immature) *asymmetrically ovoid*, *c. 3.5 × 1.7 cm*, 3-valved, *finely stellate pubescent*, dark brown.

Vernacular name. Sarawak—*ramin bukit* (preferred name).

Distribution. Endemic in Borneo, uncommon. Recorded in Sarawak from Kuching and Miri districts (e.g., *S 38308*, *S 38312*, *S 40450*, and *S 42278*). Also occurring in Brunei (e.g., *S 5928*).

Ecology. In mixed dipterocarp forest on clay and sandy soil, at 30–1100 m altitude. The flowers are whitish-creamy, sweet-scented and insect-pollinated.

Notes. The species is morphologically closely allied to *G. augescens* in its floral and fruit characters but differs by its longer petiole (1.3–1.8 cm long), smaller and narrower, smooth and shining leaves without minute appressed hairs on the lower surface, thicker inflorescence rachis, and broader bracts.

16. **Gonystylus macrophyllus** (Miq.) Airy Shaw Plate 6F.

(Greek, *makro* = large; *phullon* = leaf; large-leaved)

Kew Bull. (1947) 9, *op. cit.* (1953) 354; Backer & Bakhuizen *f. op. cit.* 401; Cockburn *op. cit.* 255; Whitmore *op. cit.* 388; Anderson *op. cit.* 333; Turner *op. cit.* 485; Coode *et al.* (eds.) *op. cit.* 322; Argent *et al.* (eds.) *op. cit.* 636. **Basionym:** *Aquilaria ?macrophylla* Miq., *op. cit.* 356. **Type:** *Diepenhorst HB 2356*, Sumatra, Priaman (holotype U). **Synonyms:** *Gonystylus miquelianus* Teijsm. & Binn., *op. cit.* 265; *G. philippinensis* Elmer, Leafl. Philip. Bot. 7 (1915) 2674; *G. obovatus* Merr., Philip. J. Sci. 12 (1917) 283.

Tree to 45 m tall, to 100 cm diameter; buttresses to 3 m tall. **Bark** thick, shallowly fissured, dark brown, densely lenticellate; inner bark pale brown, fibrous. **Twigs** *glabrous*, dark brown. **Leaves** *chartaceous to coriaceous*, *glabrous on both surfaces*, drying yellowish brown on both surfaces; *blade* oblong, elliptic, obovate or sublanceolate, (*3*–)*13*–*28*(–*40*) × (*2*–)*5*–*9*(–*15*) *cm*, base cuneate to rounded, *margin slightly revolute*, apex acuminate, rounded or caudate, acumen to 1 cm long; *midrib deeply channelled above*; *lateral veins 6–19 pairs*, with 1–2 shorter veins in between, *obscure above*, *prominulous below*; intercostal venation obscure above, visible below, irregularly areolate; *petiole 1.2–2 cm long*, sparsely tomentose or glabrous, rugose, *finely channelled above*, dark brown when dry. **Inflorescences** *14–20 cm long*, unbranched or branched, each branch bearing 4–8 clusters of flowers, each cluster with 3–5 flowers, tomentose; bracts ovate, 2–3 × 1.5 mm, tomentose. **Flowers:** pedicels *c.* 1.5 cm long, tomentose; *buds subglobose*, *7.5–8 × 5.5–6 mm*; *calyx lobes ovate-deltoid*, *4–4.5 mm long*, tomentose outside, densely velutinous inside; *petaloid appendages 20–40*, in a single whorl, linear-subulate, 2.5–3 × 0.5 mm, epustulate, sparsely setulose; stamens 16–30, 2–2.5 mm long, in a single or rarely in two whorls, filaments 1–1.5 mm long, anthers *c.* 10 × 0.5 mm, glabrous; ovary ovoid, 2–2.5 mm long, 3-loculed, densely setulose, style filiform, villous, stigma clavate; parastyles absent. **Fruits** globose, 4–7 cm diameter, 3–5-valved; pericarp fibrous, verrucose, sparsely stellate pubescent, dark brown; testa smooth. **Seeds** ellipsoid, *c.* 4 × 2.4 cm; testa glossy, brown, crustaceous.

Vernacular names. Sarawak—*ramin* (Iban, Malay), *gaharu melitan*, *melawis* (Iban).

Distribution. Nicobar Is. and widespread throughout the Malesian region, except for C and E Java and the Lesser Sunda Is. In Sabah, recorded from Sipitang district (e.g., *SAN 16732*) and in Sarawak, from Bintulu and Kapit districts (e.g., *S 21129* and *S 25455*). Also occurring in Brunei (e.g., *Niga NN 136* and *SAN 17418*) and in Kalimantan (e.g., *Kostermans 5286* and *Veldkamp 8493*).

Ecology. In primary mixed dipterocarp and lower montane forests, on clay and sandy soil, at altitudes to 1700 m.

Uses. The timber is locally used for general light construction purposes, and the infected heartwood for producing incense.

17. **Gonystylus maingayi** Hook.*f.*

(A.C. Maingay, 1836–1869, British physician and botanist, sometime jail-warden in Malacca, Peninsular Malaysia)

Fl. Brit. Ind. 5 (1890) 200; Gamble *op. cit.* 266; Ridley *op. cit.* (1922) 322; Airy Shaw *op. cit.* (1953) 359, *op. cit.* (1964) 456, *op. cit.* (1972) 978; Cockburn *l.c.* 255; Whitmore *op. cit.* 391; Anderson *op. cit.* 333; Turner *op. cit.* 485; Coode *et al.* (eds.) *op. cit.* 322; Argent *et al.* (eds.) *op. cit.* 636. **Type:** *Maingay s.n.* (= *Kew Distr. No. 1441*), Peninsular Malaysia, Malacca (holotype K).

Tree 27–40 m tall, 50–80 cm diameter. **Bark** pale grey to dark brown, slightly fissured, flaky or cracking; inner bark light red. **Sapwood** pale yellow. **Twigs** dark brown to blackish, *glabrous*. **Leaves** *chartaceous*, *glabrous*, drying dark brown above, purplish brown below; *blade* elliptic-oblong, *8–15 × 4–8 cm*, base cuneate to rounded, *margin strongly revolute*, apex acuminate to caudate, acumen to 1.5 cm long; midrib narrowly channelled above, sparsely puberulous; *lateral veins 24–30 pairs*, prominent on both surfaces; intercostal venation reticulate; *petiole 2–2.6 cm long*, sparsely tomentose, rugose, dark brown. **Inflorescences** few-branched, *18–30 cm long*, each branch with 3–6 clusters of flowers, each cluster 2–6-flowered, densely tomentose; bracts absent. **Flowers:** pedicels 1–1.5 cm long, tomentose; buds subglobose, 4.5–5 mm diameter, tomentose; calyx lobes deltoid, 3.5–5 × 2–4 mm, tomentose on both surfaces, strongly recurved at anthesis; petaloid appendages *c.* 22, subulate, 2–2.5 × 0.5 mm, epustulate, glabrous, fleshy, rigid, reddish brown when dry; stamens *c.* 22, 2–2.5 mm long, in a single whorl, filaments 1–1.5 mm long, anthers *c.* 1 × 0.5 mm, glabrous; ovary ovoid-subglobose, *c.* 3 mm long, 3-loculed, densely setulose, style elongate, wiry, *c.* 6 mm long, villous, stigma clavate; parastyles absent. **Fruits** spheroidal, 3–4 × 2.5–4 cm, 2–5-valved; pericarp thick, woody, fibrous, verrucate, sparingly stellate pubescent, dark brown. **Seeds** 1–3 per fruit, ellipsoid; testa smooth, glossy, dark brown, crustaceous.

Vernacular names. Sabah—*mitan* (Iban), *ramin* (Brunei Dusun). Sarawak—*ramin batu air* (preferred name), *ramin hitam*, *ramin paya* (Malay).

Distribution. Sumatra, Peninsular Malaysia, Singapore, and Borneo. In Sabah, recorded from Beaufort and Papar districts (e.g., *SAN 24822* and *SAN A 1703*) and in Sarawak, from Bintulu, Samarahan and Sri Aman districts (e.g., *S 14607*). Also occurring in Brunei (e.g., *BRUN 976* and *FMS 36980*).

Ecology. In primary freshwater swamp and peat swamp forests, at altitudes to 150 m.

Notes. The leaves of *Gonystylus maingayi* resemble those of *G. bancanus* but larger. The calyx lobes are strongly recurved at anthesis, similar to those of *G. forbesii* and *G. velutinus*. It differs, however, from *G. forbesii* and *G. velutinus* by the longer petiole (2–2.6 cm long), number of petaloid appendages (*c.* 22) and wiry villous style.

Uses. The timber is traded and used as that of *G. bancanus*.

18. **Gonystylus micranthus** Airy Shaw

(Greek, *mikro* = small, *anthos* = flower; small-flowered)

Kew Bull. (1950) 142, *op. cit.* (1953) 361, *op. cit.* (1964) 457; Anderson *op. cit.* 333; Argent *et al.* (eds.) *op. cit.* 636. **Type:** *Garvill S 4*, Borneo, Sarawak, Kuching district, Semengoh FR (holotype KEP; isotype SING).

Tree 18–25 m tall, 30–60 cm diameter. **Bark** dark brown, irregularly flaky; inner bark orange to reddish brown. **Sapwood** yellowish. **Twigs** 3–4 mm diameter, blackish brown, *glabrous*. **Leaves** *chartaceous to coriaceous*, *glabrous*, drying distinctly dark purplish brown on both surfaces; *blade* elliptic-oblong, *7–15 × 3–6 cm*, *base cuneate or rounded*, margin slightly revolute, apex abruptly caudate, acumen 0.6–1.2 cm long; *midrib narrowly channelled above*, puberulous below; *lateral veins 20–23 pairs*, obscure above, prominent below, intramarginal veins 0.5–1 mm from the margins; intercostal venation scalariform, faint on both surfaces; *petiole 0.8–1 cm long*, channelled above, sparsely tomentose, rugose, dark brown. **Inflorescences** few-branched, *10–15 cm long*, sparsely tomentose; bracts absent. **Flowers:** pedicels 0.2–0.4 cm long, densely tomentose; buds 2–3.5 × 2–2.5 mm, dark greyish brown tomentose; calyx lobes lanceolate to narrowly deltoid, 2–3 × 1–1.5 mm, sparsely tomentose outside, densely tomentose inside; *petaloid appendages c. 7*, in a single whorl, subulate, 2–2.5 × 0.5–1 mm, epustulate or sometimes sparsely pustulate at apex, *glabrous*; *stamens c. 6*, 1.5–2 mm long, in a single whorl; filaments 0.5–1 mm long, anthers *c.* 1 × 0.5 mm, bearded; ovary subglobose, 3-loculed, densely setulose, styles filiform, *c.* 1.5 mm long, glabrous, stigma clavate; *parastyles 4–5*, geniculate, *glabrous*. **Fruits** 3.5–4 cm long, elongate with short beaks, dark brown; pericarp fibrous.

Vernacular name. Sarawak—*ramin hitam* (Malay).

Distribution. Endemic in Borneo. Recorded in Sabah from Beaufort and Papar districts (e.g., *SAN 126551*, *SAN 126688* and *SAN 127307*) and in Sarawak from Bintulu, Kuching, Marudi, and Samarahan districts (e.g., *S 34826*, *S 38450*, *S 48929*, and *S 68890*). Also occurring in SE Kalimantan (e.g., *Kostermans 13489* and *Jarvie & Ruskandi 5559*).

Ecology. Primary lowland mixed dipterocarp and *kerangas* forests on undulating lands, on clay or sandy soil, at altitudes to 100 m.

19. **Gonystylus nervosus** Airy Shaw

(Latin, *nervosus* = distinctly veined; the leaves)

Kew Bull. 17 (1964) 452, *op. cit.* (1972) 981; Anderson *op. cit.* 333. **Type:** *Anderson S 4644*, Borneo, Sarawak, Baram district, G. Benarat (holotype K; isotypes L, SAN).

Small tree to 5 m tall, 10 cm diameter. **Twigs** terete, 3–5 mm diameter, glabrous, dark brown. **Leaves** chartaceous to thin-coriaceous, glabrous, drying greyish brown on both surfaces, *bullate*; *blade* oblanceolate or rarely oblong, *25–32 × 6–8 cm*, *base cuneate*, *margin slightly revolute*, apex narrowed to subrotunded, abruptly caudate, acumen 1–4 cm long; midrib slender, flat or impressed above, prominent and sparsely tomentose below; *lateral veins 25–44 pairs*, parallel, impressed above, sharply raised below, conspicuously arcuating and anastomosing toward the margin; intercostal venation reticulate; *petiole 1–1.5 cm long*, sparsely tomentose, rugose, dark brown when dry. **Inflorescences** few-branched, 2–4 cm long, few-flowered, greyish sericeous; bracts absent. **Flowers:** buds subglobose, 4.5–5 mm across; calyx lobes deltoid, 1.8–2.3 mm long, tomentose outside, densely velutinous inside; petaloid appendages *c.* 22, in a single whorl, linear-subulate, 2–2.5 × 0.5 mm, epustulate, glabrous; stamens *c.* 30, 1–1.5 mm long, in 3 whorls, filaments *c.* 5 mm long, anthers *c.* 1 × 0.5 mm, glabrous; ovary ovoid, 3-loculed, densely setulose, style filiform, *c.* 4 mm long, glabrous, stigma capitate; parastyles absent. **Fruits** (immature) ellipsoid, *c.* 3.5 cm long, dark brown, 3-valved, substended by persistent calyx lobes; stalk *c.* 2 cm long. **Seeds** 2 per fruit, flattened subellipsoid, *c.* 2.2 × 1.6 cm; testa shining, pale chestnut brown.

Vernacular name. Sarawak—*ramin* (Malay).

Distribution. Endemic in Borneo. Known only in Sarawak from Bintulu, Kuching and Marudi districts (e.g., *BRUN 3227*, *S 4013*, *S 12544*, *S 18189*, and *S 34778*).

Ecology. Confined to limestone hill forest, at altitudes to 450 m.

Notes. The very distinct venation on both surfaces of the bullate leaves is similar to that of *G. costalis*. However, this species differs from *G. costalis* in its glabrous petaloid appendages, glabrous style and the absence of parastyles.

20. **Gonystylus nobilis** Airy Shaw

(Latin, *nobilis* = notable or remarkable; referring to the large leaves with long, robust petiole)

Kew Bull. 23 (1969) 271, *op. cit.* (1972) 981; Anderson *op. cit.* 333. **Type:** *Ilias S 15115*, Borneo, Sarawak, Bintulu district, Ulu Segan (holotype K; isotypes L, SAN).

Tree to 25 m tall, without buttresses. **Bark** rather smooth to finely fissured, lenticellate. **Twigs** robust, to 1 cm diameter, finely striate, greyish brown. **Leaves** *stiff thick-coriaceous*, *not bullate*, *glabrous on both surfaces*, drying dull greyish green above, yellowish brown below; *blade* elliptic to suboblong, *30–35 × 9–12 cm*, base broadly cuneate-rotundate, *margin strongly revolute*, apex abruptly acuminate, acumen acute, *c.* 1 cm long; *midrib* robust, *prominent below*, *deeply narrowly impressed above*; *lateral veins 15–20 pairs*, lax, prominulous above, sharply prominent below, conspicuously anastomosing near the margins; intercostal venation reticulate; *petiole* very robust, terete, *3–4 cm long*, *c.* 5 mm thick, sparsely appressed pubescent, rugose, dark brown when dry. **Inflorescences** unbranched, 11–15 cm long, appressed pubescent. **Flowers** unknown; calyx lobes (as seen in immature fruit) 4.5–5.5 × 2.5–3 mm, tomentose outside, densely velutinous inside; petaloid appendages (as seen in immature fruit) *c.* 5 × 0.5 mm, sparsely setulose, fleshy, rigid, reddish brown when dry. **Fruits** (immature) *ellipsoid*, *c. 6.5 × 5.5 cm*, *4-valved*, *conspicuously obtusely 4-ridged*, *verrucose*, *puberulous*, greyish brown when dry; pericarp thick, fibrous. **Seeds** ellipsoid; testa glossy, crustaceous, dark reddish brown.

Vernacular name. Sarawak—*ramin bukit* (Malay).

Distribution. Endemic in Borneo; rare and known only by the type.

Ecology. In primary mixed dipterocarp forest on clay sandy and dry soil, at *c.* 300 m altitude.

Notes. The lax venation and long petiole suggest affinity with *G. macrophyllus*, but the twigs of this species are more robust.

21. **Gonystylus othmanii** Tawan

(Othman Ismawi, former research assistant at the Herbarium, Sarawak Forestry Department)

Bot. J. Linn. Soc. 130 (1999) 66. **Type:** *Tawan CST 164*, Borneo, Sarawak, Kuching district, Bako NP (holotype SAR; isotypes HUMS, KEP, SAN).

Tree to 10 m tall, 20 cm diameter; trunk straight; buttresses absent. **Bark** finely fissured, greyish brown. **Twigs** *glabrous*, rugose, dark brown. **Leaves** *chartaceous*, *sparsely tomentose below*, drying greyish brown to brown; *blade* elliptic to narrowly oblong, *9–18 × 3–6 cm*, base cuneate, margin slightly revolute, apex acuminate; midrib flat to prominulous above, prominent below; *lateral veins 21–25 pairs*, with many shorter veins in between, prominent on both surfaces; intercostals venation reticulate, inconspicuous; *petiole 0.8–1 cm long*, sparsely tomentose, rugose, drying dark brown. **Inflorescences** paniculate, *few-branched*, *7–10 cm long*, tomentose; bracts ovate, 3–4 × 2.5–3 mm, tomentose. **Flowers:** pedicels 5–7 mm long, tomentose; buds subglobose, 4–5 × 3–3.5 mm; calyx cupular, lobes 5, deltoid, 4.5–5 × 2.5–3.5 mm, tomentose outside, densely setulose inside; *petaloid appendages c. 20*, in a single whorl, linear-subulate, 1–2 × 0.5 mm, epustulate, *densely setulose*; *stamens c. 20*, 2.5–3 mm long, *in a single whorl*, filaments *c.* 1 mm long, anthers *c.* 2 × 1.5 mm, glabrous; ovary ovoid, *c.* 2 × 2 mm, 3-loculed, densely setulose, style *c.* 3.5 mm long, filiform, villous, stigma capitate; parastyles *c.* 5, clavate, *c.* 0.5 mm long, densely villous. **Fruits** (immature) ellipsoid, 4.5–5.5 cm long, with short beak, 4-valved, verrucate, sparsely hairy, dull brown when dry.

Distribution. Endemic in Borneo. Known in Sarawak from Kapit, Kuching, Lundu, and Samarahan districts (e.g., *Purseglove P 5044*, *S 36651*, *S 43911*, *S 54409*, and *S 61744*).

Ecology. In lowland mixed dipterocarp forest on sandy or loamy soil, at low altitude.

Notes. A species closely related to *G. pendulus* but differs by its lateral veins 21–25 pairs (*vs.* 9–12 pairs), petaloid appendages densely setulose (*vs.* sparsely setulose), parastyles 5 and densely villous (*vs.* 3 and glabrous), and stamens arranged in a single whorl (*vs.* in two whorls).

22. **Gonystylus pendulus** Airy Shaw

(Latin, *pendulus* = drooping; referring to the branches)

Kew Bull. (1950) 141, *op. cit.* (1953) 359; Anderson *op. cit.* 333. **Type:** *Clemens 20011*, Borneo, Sarawak, Lundu district, Mt. Pueh (holotype K).

Small tree to 10 m tall, 12.5 cm diameter. **Twigs** elongate, pendulous, *pubescent when young*, dark brown. **Leaves** *chartaceous to thin-coriaceous*, glabrous above, *appressed tomentose below*, drying greyish brown on both surfaces; *blade* oblong-elliptic to almost oblong, *8–12 × 2–4 cm*, base rounded-cuneate, margin slightly revolute, apex acuminate to shortly caudate; *midrib narrowly channelled above*, sparsely tomentose below; *lateral veins 9–12 pairs*, steeply ascending, prominent on both surfaces; intercostal venation reticulate; *petiole 0.5–0.6 cm long*, sparsely tomentose, rugose, dark brown. **Inflorescences** *3–4-branched*, *3–6 cm long*, each branch with 3–4 flowers, sparsely tomentose; bracts absent. **Flowers:** pedicels 1.5–2 cm long, tomentose; buds subglobose, 4.5–5 mm diameter; *calyx lobes narrowly to broadly ovate*, *5–6 × 3.5–4 mm*, *appressed sericeous outside*; *petaloid appendages 20–30*, in a single whorl, linear-subulate, 3.5–4.5 × 1.5 mm, epustulate, *sparsely setulose*; *stamens c. 23*, 2–3 mm long, *in two whorls*, filaments and anthers of more or less equal, 1–1.5 mm long, glabrous; ovary ovoid, densely setulose, style filiform, *c.* 3 mm long, villous, stigma clavate; *parastyles c. 3*, *c.* 0.5 mm long, *clavate*. **Fruit** unknown.

Vernacular name. Sarawak—*ramin bukit* (Malay).

Distribution. Endemic in Borneo; rare and known only by the type.

Ecology. In lower montane forest, on clay soil, at *c.* 1200 m altitude.

23. **Gonystylus spectabilis** Airy Shaw Fig. 5.

(Latin, *spectabilis* = spectacular; the golden-brown indumentum on the lower leaf surface)

Kew Bull. 23 (1969) 269, *op. cit.* (1972) 982; Anderson *op. cit.* 333; Coode *et al.* (eds.) *op. cit.* 636. **Type:** *Jugah S 23816*, Borneo, Sarawak, Kapit district, Bt. Raya (holotype K; isotypes KEP, SAN).

Tree *c.* 25 m tall, to 50 cm diameter. **Bark** dark brown, regularly flaky; inner bark orange to reddish brown. **Sapwood** yellowish. **Twigs** robust, *c.* 8 mm diameter, ridged, densely golden-brown tomentellous. **Leaves** *chartaceous to thin-coriaceous*, *not bullate*, *glabrous above except the midrib*, *densely finely velutinous with golden-brown short hairs below*, drying slightly shining above; *blade* broadly elliptic-oblong, *25–32 × 8–15 cm*, base rounded to slightly cordate, *margin strongly revolute*, apex rounded and abruptly caudate, acumen to 2.5 cm long; *midrib narrowly channelled above*, rounded, prominent, robust, and densely fulvous-tomentellous below; *lateral veins 20–25 pairs*, with up to 5 shorter veins in between, faint above, visible below, intramarginal vein 1–2 mm from the margin; intercostal venation faint above, visible below; *petiole 1.5–2.5 cm long*, densely tomentose, flat above to almost 4-angled. **Inflorescences** robust, 8–22 cm long, many-branched, many-flowered; rachis grooved, densely tawny-tomentellous; bracts absent. **Flowers:** pedicels 1.5–2.5 cm long, tomentose; buds subglobose, 6–8 mm diameter; calyx lobes 9.5–10 × 5–7 mm, tomentose outside, densely velutinous inside; *petaloid appendages 40–45*, in a single whorl, linear-subulate, 4–5.5 × 0.5 mm, epustulate, glabrous; *stamens c. 55*, 2.5–4 mm long, in a single whorl, filaments and anthers equal, 1–2 mm long, anthers glabrous; ovary ovoid, *c.* 2

mm long, 3-loculed, style filiform, *c.* 8 mm long, glabrous, stigma capitate; *parastyles absent*. **Fruits** unknown.

Vernacular name. Sarawak—*ramin* (Malay).

Distribution. Endemic in Borneo. Recorded in Sarawak from Kapit and Limbang districts (e.g., *S 28763*, *S 32371* and the type). Also occurring in Brunei (e.g., *FMS 35685*).

Ecology. In mixed dipterocarp forest on gentle slopes of spur-ridges, at altitudes to 200 m.

Notes. Allied to *G. calophylloides* and *G. calophyllus*, but differing in its dense golden-brown indumentum, its longer petiole (up to 2.5 cm long), larger number (40–45) of petaloid appendages, and its styles without parastyles.

24. **Gonystylus stenosepalus** Airy Shaw

(Latin, *stenos* = narrow, *sepalus* = sepal; having narrow calyx lobes)

Kew. Bull. (1947) 9, *op. cit.* (1953) 355, *op. cit.* (1964) 451; Cockburn *op. cit.* 254; Anderson *op. cit.* 334; Coode *et al.* (eds.) *op. cit.* 322. **Type:** *Haviland 489*, Borneo, Sarawak, Sibu district, along Rajang R. (holotype K).

Small tree to 15 m tall, to 20 cm diameter. **Twigs** *glabrous*, ochreous-brown. **Leaves** *chartaceous to coriaceous*, *glabrous*, drying yellow-ochreous on both surfaces; *blade* elliptic or oblong, *12–20 × 5–9 cm*, base rounded, *margin slightly revolute*, apex acuminate; *midrib raised and prominent above*, glabrous; *lateral veins 17–20 pairs*, prominent on both surfaces; intercostal venation reticulate; *petiole 1–1.5 cm long*, *conspicuously channelled above*, glabrous or sparsely tomentose. **Inflorescences** terminal, 4–5-branched, *4–13 cm long*, each branch with 4–6 clusters of flowers, each clusters bearing 3–6 flowers, sparsely appressed tomentose; bracts absent. **Flowers:** pedicels 1.8–2.1 cm long, tomentose; buds subglobose, 3–4 × 2–3 mm; *calyx lobes narrowly deltoid or narrowly lanceolate*, *6–7 × 1.5–2 mm*, tomentose outside, densely velutinous inside; *petaloid appendages c. 19*, in a single whorl, linear-subulate, 3.5–4 × 0.5 mm, glabrous, pustulate; stamens *c.* 18, 2.5–3 mm long, in a single whorl, filaments *c.* 1 mm long, anthers *c.* 1.5 × 0.5 mm, glabrous; ovary 3–loculed, densely setulose, styles filiform, sparsely villous, stigma capitate; parastyles 4–5, minute, rounded or geniculate, glabrous. **Fruits** uknown.

Vernacular name. Sarawak—*ramin bukit* (Malay).

Distribution. Endemic in Borneo. In Sabah, recorded from Beaufort, Kota Kinabalu, Kinabatangan, Kuala Penyu, Labuk Sugut, Sandakan, Tawau, and Tenom districts (e.g., *SAN 20485*, *SAN 21307*, *SAN 32200*, *SAN 79405*, and *SAN 125314*) and in Sarawak, from Bintulu, Kapit, Kuching, Lubok Antu, and Miri districts (e.g., *S 12824*, *S 34061*, *S 36023*, *S 38977*, and *S 43162*). Also occurring in Brunei (e.g., *Niga NN 57*).

Ecology. In primary mixed dipterocarp forest, at altitudes to 100 m.

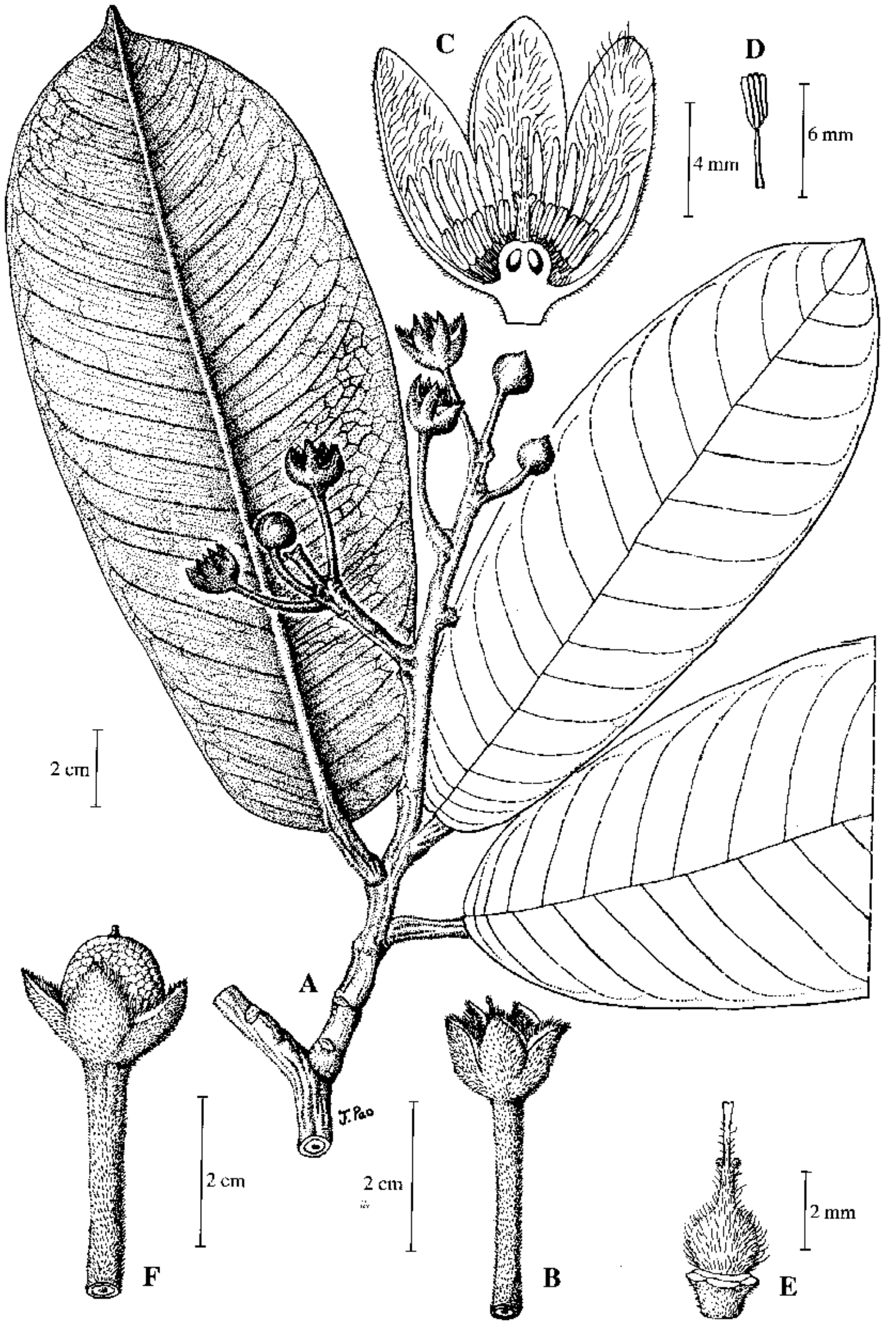

Fig. 5. *Gonystylus spectabilis.* A, flowering leafy twig; B, open flower; C, longitudinal section of open flower; D, stamen; E, gynoecium; F, very young fruit. (A from *S 28763*, B–F from *S 32371*.)

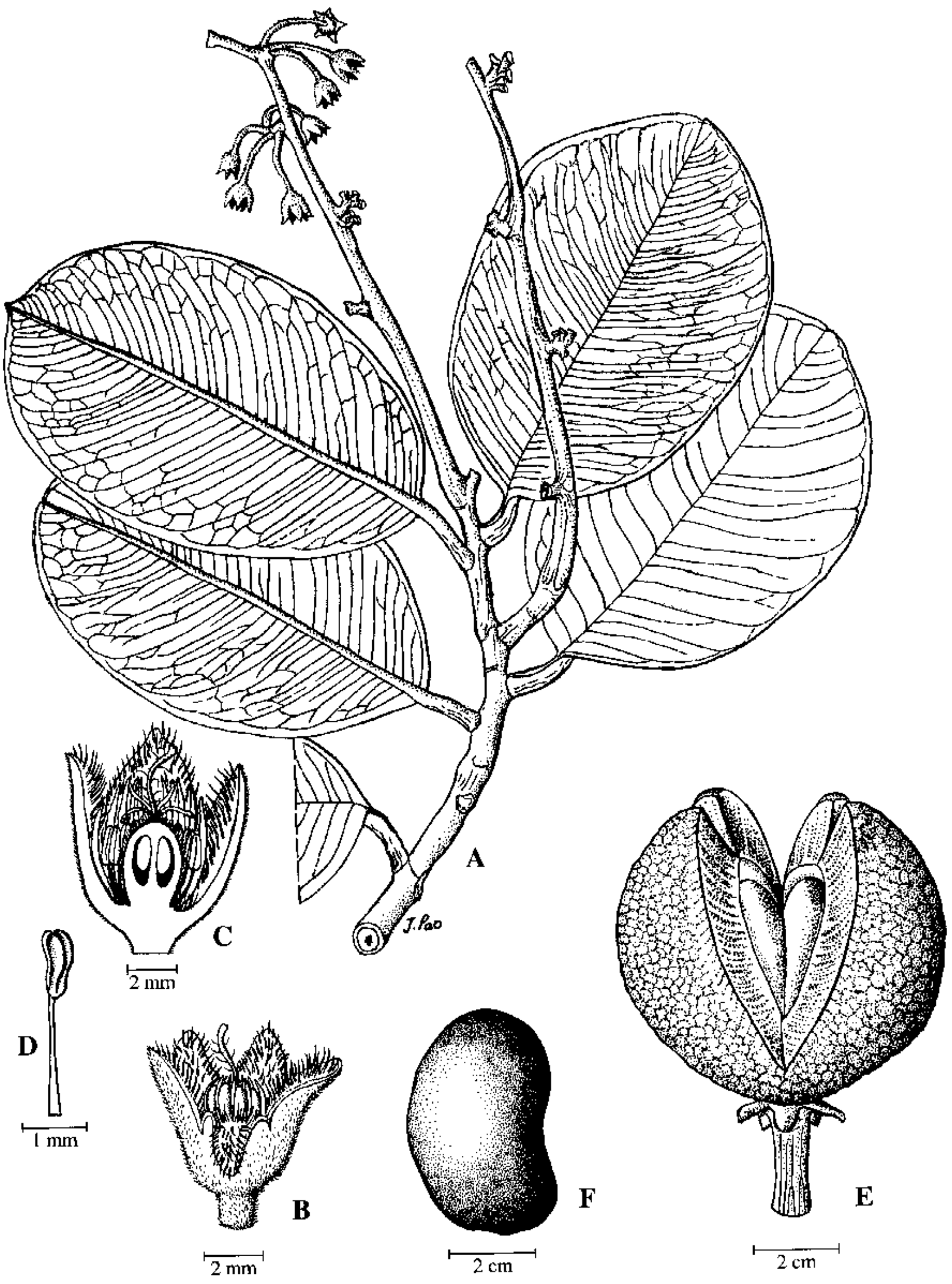

Fig. 6. *Gonystylus xylocarpus.* A, flowering leafy twig; B, open flower; C, longitudinal section of open flower; D, stamen; E, mature fruit; F, seed. (A–D from *S 13457*, E–F from *S 4660.*)

25. **Gonystylus velutinus** Airy Shaw

(Latin, *velutinus* = velvety; the indumentum)

Kew Bull. (1950) 140, *op. cit.* (1953) 359; Anderson *op. cit.* 334; Kessler & Sidiyasa *op. cit.* 227; Coode *et al.* (eds.) *op. cit.* 322; Argent *et al.* (eds.) *op. cit.* 638. **Type:** *Dorst 15T/3P/812*, Sumatra, Palembang (holotype K).

Tree 25–35 m tall, 35–70 cm diameter; buttresses to 2.3 m tall. **Bark** pale brown to reddish brown, finely fissured, flaky; inner bark yellowish brown. **Sapwood** yellow. **Twigs** dark brown, *densely reddish brown velvety*, glabrescent. **Leaves** *chartaceous to coriaceous*, glabrous and glossy above, *densely reddish brown velutinous below*, glabrescent, drying pale brown or ochreous on both surfaces; *blade* elliptic, oblong-elliptic or lanceolate-elliptic, *8–13* × *4–6 cm*, base cuneate to rotundate, margin slightly revolute, apex acuminate-caudate, acumen to 1 cm long; *midrib narrowly channelled above*, prominent below, densely hairy; *lateral veins 15–25 pairs*, with 6–8 shorter veins in between, prominulous on both surfaces, intramarginal veins 0.5–1 mm from the margin; intercostal venation visible on both surfaces; *petiole 0.5–1 cm long*, channelled above, densely velutinous. **Inflorescences** *7–14 cm long*, terminal and axillary, *2–4-branched*, each branch bearing 3–7 clusters of flowers, each cluster with 4–6 flowers, densely velutinous; bracts absent. **Flowers:** pedicels 0.6–0.7 cm long, velutinous; buds subglobose, 3–3.5 × 2.5–3.5 mm; *calyx lobes deltoid*, 3.5–4 × 1–2 mm, *velutinous on both surfaces*, *strongly revolute at anthesis*; *petaloid appendages c. 8*, subulate, 1–1.5 × 0.5 mm, epustulate, *glabrous*; *stamens c. 8*, 0.5–1 mm long, *in a single whorl*, filaments slightly shorter than anthers, bearded; ovary ovoid, 3–5-loculed, densely setulose, style filiform, glabrous, stigma clavate; *parastyles absent*. **Fruits** ellipsoid, 3.5–5.5 × 2.5–3.5 cm, 3–5-valved, woody; pericarp firmly fibrous, thick, verrucate, reddish brown or brown. **Seeds** 1–3 per fruit, ovoid, dorsiventrally compressed, 2.5–3 cm long; testa smooth, glossy, dark brown.

Vernacular name. Sarawak—*ramin batu* (Malay).

Distribution. Sumatra and Borneo. In Sabah, known from Kinabatangan and Sipitang districts (e.g., *SAN 16262* and *SAN 138225*) and in Sarawak, from Kuching, Lundu and Samarahan districts (e.g., *S 16983*, *S 37000* and *S 41126*). Also occurring in Brunei (e.g., *BRUN 147*) and Kalimantan (e.g., *bb. 17012*, *bb. 29341* and *bb. 31632*).

Ecology. In mixed dipterocarp and *kerangas* forests, over clay and sandy clay soils, at altitudes to 100 m.

Notes. A species closely resemble *G. forbesii* and *G. maingayi* in its floral characters but differs from both by its densely velutinous leaves and bearded anthers.

Uses. The timber is used for planks and house construction.

26. **Gonystylus xylocarpus** Airy Shaw Fig. 6.

(Greek, *xylos* = wood, *karpos* = fruit; with woody fruit)

Kew Bull. (1952) 73, *op. cit.* (1953) 355, *op. cit.* (1964) 450, *op. cit.* (1972) 978; Anderson *op. cit.* 334; Argent *et al.* (eds.) *op. cit.* 638. **Type:** *Omar 58*, Borneo, Sarawak, Simunjan district, G. Ngili FR (holotype SING; isotype KEP).

Tree 30–36 m tall, 40–80 cm diameter; trunk straight, buttresses to 3 m tall. **Bark** deeply fissured, 3–5 mm thick, reddish brown to dark brown; inner bark reddish brown. **Sapwood** cream or yellowish. **Twigs** glabrous, dark brown to blackish. **Leaves** *thick-coriaceous*, *stiff*, glabrous and brown or dark brown above, *greyish brown or brown and sparsely puberulous on the midrib below*; *blade* broadly elliptic, *7–17 × 5–9 cm*, base rounded or obtuse, *margin strongly revolute*, apex rounded or shortly-apiculate; midrib narrowly channelled above, rounded and prominent below, sparsely tomentose; *lateral veins 15–20 pairs*, rather obscure on both surfaces, intramarginal veins 2–3 mm from the margins; intercostal venation visible on both surfaces; petiole 1–2 cm long, sparsely tomentose, rugose, dark brown. **Inflorescences** robust, 15–20 cm long, 3–5-branched, each branch bearing 6–8 clusters of flowers, each cluster with 4–12 flowers; bracts absent. **Flowers:** pedicels 2–2.5 cm long, greyish sericeous; buds subglobose, 4–5 mm diameter, tomentose; calyx lobes lanceolate or narrowly deltoid, 6–7 × 1.5–3 mm, tomentose outside, densely velutinous on the inner central part; *petaloid appendages 30–40*, narrowly subulate, 3–4 × 0.5 mm, *sparsely setulose to glabrous*, epustulate; *stamens c. 25*, 1.5–2.5 mm long, in a single whorl, filaments 1–1.5 mm long, anthers 0.5–1 × 0.5 mm, glabrous; ovary superior, obovoid, *c.* 3 mm long, 5-loculed, densely setulose, styles filiform, pilose below, stigma clavate; *parastyles 4–5*, *c.* 1.5 mm long, flattened-clavate, villous. **Fruits** *globose to ellipsoid-globose*, *5–9 × 4.5–7.5 cm*, *without a beak*, woody, thick-walled, 4-valved, warty, puberulous; pericarp fibrous. **Seeds** ellipsoid, to 3.5 × 2 cm, dark brown, stony; testa smooth, glossy, crustaceous.

Vernacular names. Sarawak—*gaharu melitan* (Iban), *ramin bukit* (Malay).

Distribution. Endemic in Borneo. In Sarawak, known from Kuching, Lundu and Simunjan districts (e.g., *S 4660*, *S 13457*, *S 50152*, and *S 56615*). Also occurring in Brunei (e.g., *BRUN 5633*) and in Kalimantan (e.g., *bb. 11350*).

Ecology. Primary mixed dipterocarp and *kerangas* forests on clay and sandy soil, at altitudes to 250 m.

Uses. The wood is an important source of *ramin* timber.

Incompletely known species

Gonystylus sp. 1.

Tree to 9 m tall, to 10 cm diameter. **Bark** smooth, greyish brown; inner bark reddish. **Sapwood** pinkish. **Twigs** terete, glabrous, lenticellate and dark brown to blackish when young, becoming pale cream with the lenticels breaking-up longitudinally when older. Vegetative buds enclosed by a pair of overlapping, ovate stipules. **Leaves** thickly coriaceous, pustulate and glabrous on both surfaces; blade elliptic-oblong, 6–10 × 2–5 cm, base obtuse or rounded, margin slightly wavy, apex acute with short acumen to 5 mm long; midrib glabrous, raised on both surfaces; lateral veins 14–16 pairs, lax, distinctly pustulate-granulate on both surfaces, slightly raised above, distinctly raised below, thinning, looping and forming intramarginal vein loop 5–7 mm from the margins; intercostal venation reticulate, distinctly raised and pustulate-granulate on both surfaces; petiole 0.4–0.5 cm long, distal end furrowed on the adaxial side, flat at the proximal end, glabrous, drying blackish brown. **Inflorescences** terminal or axillary tomentellous panicles, 9–19 cm long; main branches 4–5, each with 9 or more branchlets; each branchlet bearing 1–3 flowers; peduncles 2–3 mm long; bracts ovate, 2–3 × 1–2 mm, tomentellous outside, glabrous inside; bracteoles ovate, 1.8–2 × 1–2 mm, sericeous outside, glabrous or glabrescent inside. **Flowers:** buds ellipsoid, 2–3 × 1.3–2.5 mm, densely pubescent; sepals 5, aestivation equitans, outer most sepal *c*. 1.5 × 1 mm, inners most one *c*. 1 × 0.3 mm, densely pubescent, thickened at the middle, gradually thinner toward margins; petaloid appendages 5, free, valvate, papery to almost transparant, ovate, *c*. 0.6 × 0.5 mm, glabrescent outside, glabrous inside, sericeous on the distal parts along margins; stamens *c*. 15, filaments 0.2–0.5 mm long, anthers basifixed, 0.5–0.6 mm long; ovary ovoid, 1–2 × 1–1.5 mm, densely pubescent; parastyles 1 or 2, elongate, 1.3–1.8 mm long, villose, blackish brown. **Fruits** (immature) 1-seeded, obovoid to subglobose, slightly compressed, 1.5–2.5 × 1.5 cm, apex slightly cordate, verrucose, sparsely setulose, especially at base; pericarp fibrous, *c*. 2.6 mm thick, inner surface tomentellous. **Seeds** globose; testa smooth, brownish.

Distribution. Known by a single collection (*i.e.*, *SAN 83819*) from Nabawan, Keningau district, Sabah.

Notes. This species differs from the previously known species of the genus occurring in Sabah and Sarawak by its pustulate-granulate lateral and intercostal veins, overlapping stipules enclosing vegetative buds, equitans aestivation of sepals, and its 5, free, thin-papery petaloid appendages with sericeous apex. More specimens are, however, needed to establish its correct taxonomic status.

5. **PHALERIA** Jack

(Greek, *phaleros* = glossy white; the flowers)

Mal. Misc. 2 (1822) 59; Hooker *f.*, Fl. Brit. Ind. 5 (1890) 199; Domke, Bibl. Bot. 27, Heft 111 (1934) 123; Merrill, J. Arn. Arb. 33 (1952) 239; Ding Hou, FM 1, 6 (1960) 15; Backer & Bakhuizen *f.*, FJ 1 (1964) 268; Cockburn, TS 1 (1976) 253.

Shrubs or trees. **Leaves** *decussate or opposite*, *without translucent glandular dots*, pinnately veined; *lateral veins curved*; *intercostal venation reticulate or scalariform*. **Inflorescences** terminal or axillary, sometimes borne on older branches and/or stems, capitate, fascicled or umbelliform, peduncled, rarely sessile; peduncles usually with decussate, persistent, reddish brown, glabrous bracteoles towards the base. **Flowers** white, sessile, articulated at the base; calyx tube funnel-shaped or cylindrical, glabrous or puberulous on both sides, lobes 5, rarely 4 or 6, slightly unequal; *petaloid appendages obscure and rim-like*, *or absent*, *rarely distinct*; *stamens twice the number of calyx lobes*, in two whorls, usually filamentous and exerted, sometimes included, rarely sessile, anthers oblong, dorsifixed; disk cupular, submembranaceous; *ovary* ovoid or ellipsoid, glabrous or hairy at the apex, *2-loculed or rarely 1-loculed*, style terminal, filiform, sometimes exserted, stigma capitate, papillose. **Fruits** *drupaceous*, *1–2-seeded*; exocarp and mesocarp fibrous and fleshy (sometimes hard in dried specimens); endocarp coriaceous and hard. **Seeds** without endosperm; cotyledons thick and hemispherical.

Distribution. A genus comprising about 20 species, distributed from Sri Lanka to SE Asia, throughout Malesia to Australia, Micronesia and the Pacific Is. (as far as Samoa and Tonga). In Sabah and Sarawak, two species are recognised.

Ecology. In mixed dipterocarp and lower montane forests, at altitudes to 1400 m.

Key to *Phaleria* species

Leaves elliptic-oblong, (11–)15–21(–26) × (3–)5–7(–10) cm; lateral veins 8–10 pairs; petiole to 0.5 cm long. Inflorescence usually 8-flowered, sometimes borne on older branches and stems and many-flowered. Ovary glabrous. Fruits subglobose, 1–1.5 cm diameter, usually 2-loculed and 2-seeded……………………………………………………………………**1. P. capitata**

Leaves oblong-lanceolate, oblanceolate, or ovate-oblong, 11–33 × 3–14 cm; lateral veins (8–) 13–22 pairs; petiole to 1.5 cm long, slightly winged. Inflorescence 20–many-flowered. Ovary usually hairy at the top. Fruits ovoid, gradually narrowed towards apex, 1.5–3 × 1–2 cm, usually 1-seeded…………………………………………………………**2. P. perrottetiana**

1. **Phaleria capitata** Jack Fig. 7.

(Latin, *capitatus* = with a knob-like tip; the stigma)

Mal. Misc. 2 (1822) 59; Backer & Bakhuizen *f.*, *op. cit.* 268; Ding Hou *op. cit.* (1960) 20; Whitmore, TFM 2 (1973) 384; Turner, Gard. Bull. Sing. 47 (1995) 485. **Type:** unknown. **Synonym:** *P. cauliflora* Bedd., For. Man. Bot. (1873) 180.

Shrub or small tree to 10 m tall, to 15 cm diameter. **Twigs** reddish brown. **Leaves** chartaceous, glabrous, drying reddish brown above, pale brown below; *blade elliptic-oblong*, *11–26 × 3–10 cm*, base acute to attenuate or sometimes rounded, margin sometimes revolute, apex narrowly acute to acuminate; midrib raised on both surfaces; *lateral veins 8–10 pairs*; intercostal venation laxly reticulate, distinct below, obscure above; *petiole to 0.5 cm long*, glabrous. **Inflorescences** *usually 8-flowered*, *axillary or borne on older branches or stems*, subsessile or with short peduncles, with decussate, small bracts at the base; involucral bracts 4, oblong, ovate or obovate, *c.* 6 × 3 mm. **Flowers** 2.5–4.5 cm long; calyx tube cylindrical, gradually enlarged towards the top, glabrous on both surfaces, lobes oblong or elliptic, 6–7 × 2–3.5 mm, puberulous inside towards the upper part and margin; stamens and style usually exerted, sometimes to 5 mm long; disk cupular; *ovary* ellipsoid, *glabrous*, apex narrowed into a filiform style, stigma capitate, *c.* 1.5 × 1 mm. **Fruits** *subglobose*, *1–1.5 cm diameter*, apex sometimes short-acute, *usually 2-loculed*, *2-seeded*; endocarp inside with distinct meshes.

Distribution. Sri Lanka, Carolines Is., Sumatra, Peninsular Malaysia, Borneo, Sulawesi, the Philippines, Maluku, and New Guinea. In Borneo, recorded in Sabah from Lahad Datu, Sandakan and Tawau districts (e.g., *SAN 129460*, *SAN A 3140* and *SAN A 3457*) and in Kalimantan (e.g., *Kostermans 21276*).

Ecology. In primary and secondary forest, at altitudes to 1200 m.

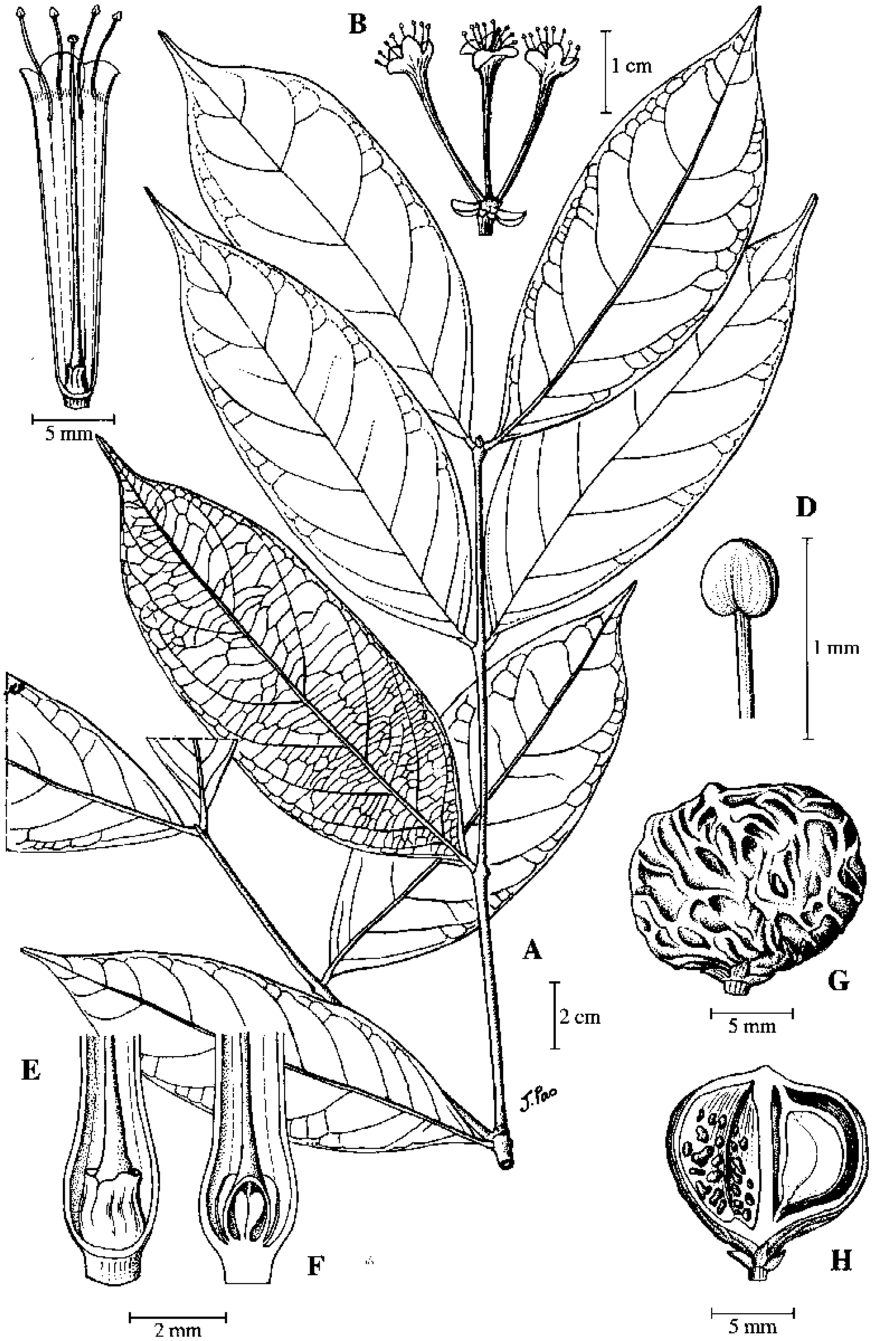

Fig. 7. *Phaleria capitata.* A, leafy twig; B, part of inflorescence; C, longitudinal section of open flower; D, stamen; E, lower portion of gynoecium; F, longitudinal section of gynoecium; G, fruit; H, longitudinal section of fruit. (A and G from *Kostermans 21276*, B–F and H from *SAN 135796*.)

Uses. Often cultivated as an ornamental. Tough fibres of the bark have been used for cordage and tying material. The fruits are sweet and edible. The seeds are used to treat scurfy eruptions in children.

2. **Phaleria perrottetiana** (Decne.) F.-Vill.

(G.S. Perrottet, 1793–1870, Swiss-born French botanist)

Nov. App. (1880) 183; Merrill, Sp. Blancoan. (1918) 378, En. Philip. Pl. 3 (1923) 131; Masamune, EPB 511; Ding Hou *op. cit.* (1960) 18. **Basionym:** *Drimyspermum perrotitianum* Decne., Ann. Sci. Nat. Bot. 2, 19 (1843) 40. **Type:** unknown. **Synonym:** *Phaleria splendida* Valeton, Ic. Bog. 4 (1913) 219.

Shrub or small tree, to 8 m tall. **Twigs** glabrous, dark brown. **Leaves** chartaceous; *blades oblong-lanceolate*, *oblanceolate*, *or ovate-oblong*, *11–33 × 3–15 cm*, base cuneate or rounded, margin slightly revolute, apex acuminate; midrib channelled above, raised below; *lateral veins 8–22 pairs*, distinct and elevated on both surfaces, curving and ascending towards the margin; intercostal venation reticulate; *petiole to 1.5 cm long*, *sligthly winged*. **Inflorescences** *20–many-flowered*, terminal or axillary at the terminal node, sometimes in the axil of the two nodes of the branch, solitary, very rarely more than one in the same axil; peduncle to 3.5 cm long; bracts small, lanceolate, *c.* 3 mm long, densely decussate at the basal part of the peduncle, persistent; involucral bracts 4, caducous after anthesis, rarely persistent, oblong, obovate-oblong, *c.* 15 × 8 mm, apex apiculate or obtuse, densely puberulous towards the upper part on both surfaces. **Flowers** 2–4.5 cm long; calyx tube pubescent outside, villous at the lower half or lower 2/3 inside, lobes 5–9 mm long; stamens and style *c.* 10 mm long, exerted beyong the tube; disk cupular, sometimes with 6–7 free lobes; *ovary usually hairy at the apex or on one side*, usually 2-loculed, sometimes 1-loculed. **Fruits** *usually 1-seeded*, *ovoid*, *1.5–3 × 1.5–2 cm*, *gradually narrowed towards the apex*, acute at the base. **Seeds** ellipsoid, *c.* 1 × 0.8 cm.

Distribution. Borneo, the Philippines, New Guinea, Louisiades Archipelago, and Admiralty Is. In Borneo, known from Kudat and Lahat Datu districts in Sabah (e.g., *SAN 16147* and *SAN 31642*).

Ecology. In forest, at altitudes to 1140 m.

6. **WIKSTROEMIA** Endl., *nom. cons.*

(J.E. Wikström, 1789–1856, former Professor at the Stockholm University, Sweden)

Prod. Fl. Norfolk. (1833) 47 ('*Wickstroemia*'); Hooker *f.*, Fl. Brit. Ind. 5 (1890) 195; Gamble, J. As. Soc. Beng. 75, 2 (1912) 258; Ridley, FMP 3 (1924) 144; Domke, Bibl. Bot. 27, Heft 111 (1934) 124; Ding Hou, FM 1, 6 (1960) 28; Backer & Bakhuizen *f.*, FJ 1 (1964) 268; Whitmore, TFM 2 (1973) 384; Anderson, CLTS (1980) 334; Coode *et al.* (eds.), CLBD (1996) 322.

Shrubs or trees. **Leaves** *opposite or decussate*, very rarely ternate, *without translucent glandular dots*, *pinnately veined*; *lateral veins curved*; *intercostal venation reticulate or scalariform*. **Inflorescences** terminal and/or axillary, fascicled or solitary, spicate, racemose, umbelliform or capitate, *often ebracteate*. **Flowers** subsesile or distinctly pedicelled, 4–5-merous; pedicels articulated; calyx tube cylindrical or tubular, sometimes sligthly funnel-shaped, usually caducous after anthesis, rarely persistent, lobes usually in two pairs, imbricate; *petaloid appendages absent*; stamens sessile or filamentous, *twice as many as the calyx lobes*, included, in two distinct whorls, usually free, anthers oblong, basifixed; disk membranaceous, cupular and sligthly crenate or dentate, deeply lobed, or free and scale-like; *ovary* usually ellipsoid, *glabrous or hairy at the top*, *1-loculed*, style terminal, short, distinct or obscure, stigma large, capitate or disciform, rarely cylindrical to ovoid. **Fruits** drupaceous, *1-seeded*, sometimes surrounded by dried remains of calyx tube; pericarp fleshy or membranaceous. **Seeds** of the same shape as the fruit; embryo with thickened or flattened cotyledons and short or sligthly elongated hypocotyl.

Distribution. About 70 species, distributed from SE Asia, through Malesia to Australia, Fiji and Polynesia. In Sabah and Sarawak, six species are recognised.

Ecology. Common in forested slopes, at low to medium altitudes to 1300 m.

Key to *Wikstroemia* species

1. Lateral veins straight and merging into a distinct intramarginal veins…………………..…...

   W. brachyantha Merr.

   (Greek, *brachy-* = short, *anthos* = flower; with short flowers)

   Philip. J. Sci. 13 (1918) Bot. 313, Enum. Philipp. Pl. (1923) 132; Ding Hou *op. cit.* 31. Type: *Ramos BS 30392*, the Philippines, Luzon, Catanduanes (PNH). Synonym: *Wikstroemia crassifolia* Merr. *ex* Domke *op. cit.* tab. facing p. 58.

   Shrub or small tree, to 3.5 m tall. Young twigs puberulous, light brown, older ones reddish brown, usually fissured. Leaves subcoriaceous to coriaceous, rarely chartaceous, drying olivaceous-brown to brownish on both surfaces, glabrous and shinny; blade elliptic-oblong to ovate-oblong, 5–15 × 2.5–5 cm, base obtuse to cuneate, apex acuminate; midrib channelled above, raised below; *lateral veins* 12–15 pairs, elevated and prominent below, *straight and merging into distinct intramarginal veins*; intercostal venation reticulate; petiole 0.2–0.3 cm long, glabrous. Inflorescences terminal or/and in the leaf axils of terminal nodes, distinctly peduncled; peduncles stout, brownish-pubescent. Flowers yellowish, yellowish green or green, subsessile; calyx tube 10–12 mm long, sparsely puberulous outside, glabrous inside, lobes 4, ovate-oblong, 1.5–3 mm long, obtuse; stamens in two whorls close to each other, filaments short, anthers oblong, obtuse, *c.* 1.5 mm long; disk 2, free, oblong, 2-lobed, scales-like; ovary ellipsoid or slightly obovoid-oblong, *c.* 3 mm long, hairy at the top, style distinct, filiform, *c.* 1 mm long, stigma globose, papilose. Fruits red, broadly ellipsoid, *c.* 12 × 9 mm.

   Borneo and the Philippines. In Sabah, known from the Kinabalu NP (e.g., *Wong WKM 2395*). In lowland to montane forests, at altitudes to 2800 m.

   Lateral veins curving upwards and not merging into intramarginal veins…………………2

2. Low shrubs, to 3 m tall…………………………………………………………….…3

   Tall shrubs to small trees, to 10 m tall…………………………………………………..…4

3. Leaves ovate, elliptic to lanceolate, 1.5–5.5(–8) × 1–2.5(–4) cm, base acute, apex acute to narrowly acute; intercostal venation distinct below...……………………………………..

W. androsaemifolia Decne.

(Latin, with leaves resembling those of *Androsaemum* Duhamel = syn. of *Hypericum* L., Guttiferae)

Ann. Sci. Nat. Bot. 2, 20 (1843) 50; Ding Hou *op. cit.* 33; Cockburn, TS 1 (1976) 253; Turner, Gard. Bull. Sing. 47 (1995) 485; Coode *et al.* (eds.) *op. cit.* 322. Type: *Leschenault s.n.*, Java (holotype P; isotype L).

Shrub to 2.5 m tall. Leaves chartaceous, glabrous, rarely sparsely hairy on the veins below; *blade ovate*, *elliptic to lanceolate*, *1.5–5.5(–8)* × *1–2.5(–4) cm*, *base acute*, *apex acute to narrowly acute*; midrib raised on both surfaces; *lateral veins* 8–11 pairs, elevated below, impressed above, *curving upwards but not merging into intramarginal veins*; *intercostal venation reticulate*, *distinct below*; petiole *c.* 0.2 cm long. Inflorescences umbel-shaped or spicate, 5–10-flowered, terminal or axillary; peduncle to 3.5 cm long. Flowers: pedicels *c.* 1 mm long, articulated at base; calyx tube 9–12 mm long, sparsely hairy outside, lobes oblong or ovate, fleshy, 2–3.5 mm long; stamens filamentous, anthers *c.* 1 mm long; ovary ellipsoid or obovoid, 1.5–2.5 mm long, pilose at the top, style *c.* 1 mm long, stigma globose. Fruits oblong or rounded.

Borneo, Java, Lesser Sunda Is., Sulawesi, and W New Guinea. In Sabah, known from Penampang and Pensiangan districts (e.g., *SAN 111261* and *SAN 127978*) and in Sarawak, from Lubok Antu, Marudi, Sri Aman, and Tatau districts (e.g., *S 19195*, *S 30437*, *SAN 33941*, and *S 45046*). In lowland to lower montane forests, at altitudes to 1800 m.

Leaves obovate-oblong, elliptic-oblong, oblanceolate or elliptic, 1.5–4.5(–7) × 0.5–2(–3) cm, base cuneate to attenuate, apex rounded, obtuse or acute; intercostal venation obscure or invisible on both surfaces……………………….……………………………………..

W. indica (L.) C.A.Mey.

(of India)

Bull. Acad. Sci. St. Petersb. 1 (1843) 357; Hooker *f. op. cit.* 195; Merrill *op. cit.* (1918) 279, *op. cit.* (1923) 132, 195; Ding Hou *op. cit.* 34; Backer & Bakhuizen *f. op. cit.* 269; Turner *op. cit.* 485. Basionym: *Daphne indica* L., Sp. Pl. (1753) 375. Type: *Herb. Linn. 500/11* (LINN). Synonyms: *Daphne aquilaria* Blanco, Fl. Filip. (1837) 310; *Wikstroemia linearifolia* Elmer, Leafl. Philip. Bot. 2 (1910) 680; *W. pulgarensis* Elmer, Leafl. Philip. Bot. 5 (1913) 1844; *W. pachyphylla* Merr., Philip. J. Sci. 12 (1917) 297, EB (1921) 417, Masamune, EPB (1942) 511, Heine, Pfl. Clemens Kinabalu (1953) 69.

Shrub to 3 m tall. Leaves chartaceous to subcoriaceous, drying brown to reddish brown, shining above, dull and sparsely puberulous below; *blade obovate-oblong*, *elliptic-oblong*, *oblanceolate*, *or elliptic*, *1.5–4.5(–7)* × *0.5–2(–3.5) cm*, *base cuneate to attenuate*, margin usually cartilagenous, *apex rounded*, *obtuse or acute*; midrib chanelled above, raised below; *lateral veins* 5–12 pairs, irregular, often branched, *curving upwards but not merging into intramarginal veins*, distinct below obscure above; *intercostal venation obscure or invisible on both surfaces*; petiole *c.* 0.2 cm long. Inflorescences terminal, few-flowered, subsessile or sometimes with a very short peduncle. Flowers: pedicels 1.5–2 mm long, articulated at base; calyx tube 10–12 mm long, sparsely puberulous outside, glabrous inside; calyx lobes 2–3 mm long; stamens with short filaments, anthers linear, *c.* 1 mm long; disk 2, free, linear; ovary ovoid or ellipsoid, *c.* 1.5 cm long, style very short or obscure, stigma globose, *c.* 0.3 mm diameter. Fruits broadly ellipsoid, *c.* 6 × 4 mm.

India, SE Asia, Malesia (except Java and Lesser Sunda Is.), Australia, and Melanesia (as far as Fiji). In Sabah, known from Kinabatangan and Lahad Datu districts (e.g., *SAN 133954* and *SAN A 4285*) and in Sarawak, from Kuching and Miri districts (e.g., *Argent & Jeremy 1050*, *S 38546* and *S 44764*). In various types of vegetation from the lowland to 1300 m altitude.

4. Leaves discolourous on drying. Inflorescences 1–5-flowered, usually axillary and occurring in several subsequent leaf axils along the twigs……………..…**3. W. tenuiramis**
Leaves concolourous on drying. Inflorescences 6–many-flowered, usually terminal and/or in the leaf axils of terminal nodes……………………………………………………..…5

5. Leaves ovate or ovate-oblong, 4–14 × 3.5–5 cm, base obtuse or cuneate, rarely subcordate. Flowers articulated at the top of pedicels, in falling leaving short stalks on the rachis……....
……………………………………………………………………………..**1. W. ovata**
Leaves ovate-oblong, elliptic-oblong or lanceolate 6–9(–12) × 1.5–3.5(–4.5) cm, base acute to cuneate, sometimes obtuse or rounded. Flowers articulated at the base of pedicels, in falling leaving prominent scars or short protuberances on the rachis…...**2. W. polyantha**

1. **Wikstroemia ovata** C.A.Mey. *ex* Meisn.

(Latin, *ovatus* = egg-shaped in outline; the leaves)

In DC., Prod. 14 (1857) 544; Miquel, Fl. Ned. Ind. 1, 1 (1858) 880; Merrill, Philip. J. Sci. 1 (1906) Suppl. 101, *op. cit.* (1923) 133; Masamune *op. cit.* 511; Ding Hou *op. cit.* 31; Anderson *op. cit.* 334. **Type:** *Cuming 458*, the Philippines (isotype L).

Shrub or small tree to 5 m tall. **Twigs** appressed-hirtellous, glabrescent or glabrous. **Leaves** membranaceous or chartaceous, glabrous, rarely sparsely pubescent on the midrib below, *drying concolourous*, brown; *blade ovate to ovate-oblong*, *4–14 × 3.5–5 cm*, *base obtuse or cuneate*, *rarely subcordate*, apex acuminate; midrib flat above, raised below; *lateral veins* 8–12 pairs, *curving upwards but not forming intramarginal vein*, slightly elevated below, distinct above; intercostal venation reticulate, distinct below, obscure above; petiole *c.* 0.3 cm long, sparsely appressed-hirtellous. **Inflorescences** *terminal*, short-spicate or umbelliform, peduncled, sparsely puberulous, sometimes with 1 or 2 caducous bracts, *7–20-flowered*. **Flowers** greenish yellow, short-pedicelled, *articulated at the top of pedicels*, *in falling leaving short stalks on the rachis*; calyx tube cylindrical, 15–20 mm long, sparsely puberulous outside, lobes oblong, obtuse, 2–4 mm long; stamens sessile or on short filaments, anthers 1–1.5 mm long, slightly apiculate; disk 2, free, oblong, scales-like; ovary ellipsoid, 2–3 mm long, hairy at the apex, style distinct, filiform, stigma capitate. **Fruits** subglobose to slightly ellipsoid, 0.8–1 × 0.6–0.8 cm.

Vernacular name. Sabah—*pait-pait* (Bajau).

Distribution. Borneo and the Philippines. In Sabah, recorded from Ranau district (e.g., *SAN 65218*) and in Sarawak, from Lawas and Miri districts (e.g., *Nooteboom & Chai 2319* and *S 50943*).

Ecology. In thickets, primary and secondary forests, at altitudes to 800 m.

2. **Wikstroemia polyantha** Merr.

(Greek, *poly-* = many, *anthos* = flower; with many flowers)

Philip. J. Sci. 10 (1915) Bot. 332, *op. cit.* (1923) 133; Ding Hou *op. cit.* 32; Backer & Bakhuizen *f. op. cit.* 269; Turner *op. cit.* 485. **Type:** *Reillo BS 19243*, the Philippines, Luzon (PNH). **Synonyms:** *Wikstroemia candolleana auct. non* Meisn.: Ridley, Trans. Linn. Soc. Bot. 11 (1893) 341, J. Str. Br. Roy. As. Soc. 35 (1901) 180, *op. cit.* (1924) 145; *W. junghuhnii auct. non* Miq.: Koorders & Valeton, Bijdr. Booms. Java 13

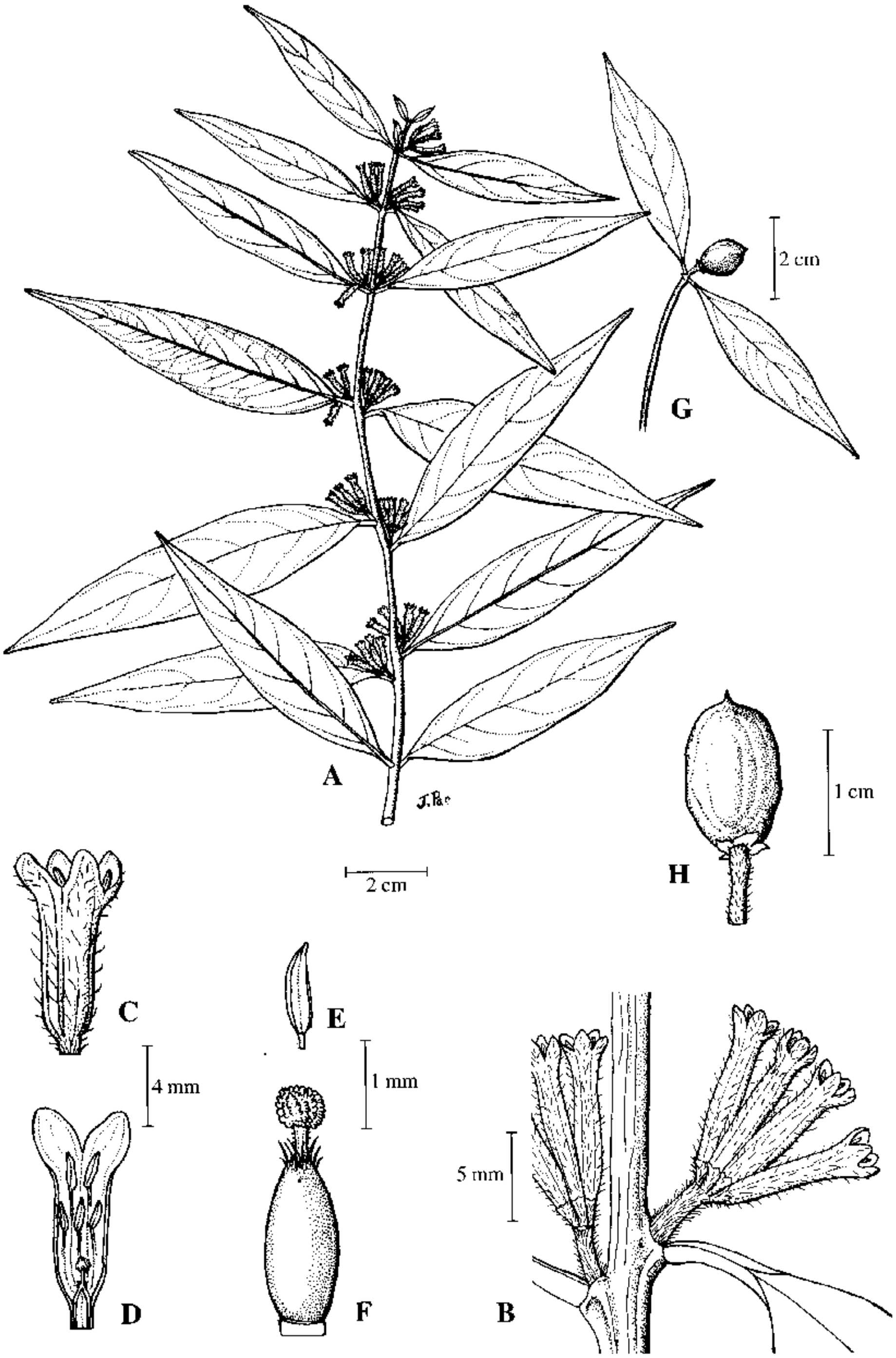

Fig. 8. *Wikstroemia tenuiramis*. A, flowering leafy twig; B, inflorescence; C, open flower; D, longitudinal section of open flower; E, stamen; F, gynoecium; G, fruiting leafy twig; H, fruit. (A–F from *S 8444*, G–H from *S 52466*.)

(1914) 58; *W. ridleyi auct. non* Gamble: Gibbs, J. Linn. Soc. Bot. 42 (1914) 132, Merrill *op. cit.* (1921) 417; *W. calva* Backer, Blumea 5 (1945) 494.

Small tree, *to 7 m tall*, *to 8 cm diameter*. **Twigs** reddish to dark brown, sparsely puberulous, glabrescent. **Leaves** membranaceous to chartaceous, rarely subcoriaceous, glabrous on both surfaces, rarely sparsely pubescent on the midrib below, *drying concolourous*, *light-brown to dark-brown*; *blade elliptic-oblong or lanceolate*, *6–12 × 1.5–3.5 cm*, *base acute to cuneate*, *sometimes obtuse or rounded*, margin slightly recurved, apex acuminate; midrib flat above, raised below; *lateral veins* 8–15 pairs, irregular, often branched, *curving upwards but not merging into intramarginal veins*, elevated below, distinct or plane above; intercostal venation reticulate; petiole 0.2–0.4 cm long, sparsely pubescent. **Inflorescences** *terminal or axillary on the terminal nodes*, spicate, up to 4 cm, erect or slightly curved, *6–many-flowered*; peduncle distinct, sparsely hairy. **Flowers** yellow, yellowish green or rarely white, loosely arranged on the rachis; *pedicels*, 0.5–1 mm long, puberulous, *articulated at the base*, *in falling leaving prominent scars or short protuberances on the rachis*; calyx tube *c.* 10 mm long, sparsely puberulous outside, glabrous inside, lobes oblong or ovate-oblong, 1.5–3.5 mm long; stamens in 3 whorls, anthers linear, *c.* 1 mm long, filament *c.* 0.5 mm long; disk 2, free, linear or obovate-oblong, *c.* 1 mm long, irregularly lobed or dentate; ovary ellipsoid or obovoid, 1.5–2.5 mm long, glabrous or sparsely hairy at the top, style distinct, stigma globose or oblong, *c.* 0.5 mm long, papillose. **Fruits** ovoid, *c.* 0.9 × 0.6 cm, red.

Vernacular name. Sabah—*chandan pelanduk* (Malay).

Distribution. Sumatra, Peninsular Malaysia, Java, Borneo, and the Philippines. In Sabah, recorded from Kuala Penyu, Ranau and Sipitang districts (e.g., *SAN 33594* and *SAN 114892*) and in Sarawak, from Kuching and Lawas districts (e.g., *S 31573* and *S 37129*).

Ecology. In mixed dipterocarp to montane forests, at altitudes to 2200 m.

Uses. The infected heartwood is used for incense.

3. **Wikstroemia tenuiramis** Miq. Fig. 8.

(Latin, *tenuis* = thin, slender, *ramus* = branch; with thin or slender branches)

Fl. Ned. Ind., Suppl. (1861) 141 & 354; Ding Hou *op. cit.* 31; Anderson *op. cit.* 334; Coode *et al.* (eds.) *op. cit.* 322. **Lectotype** (Ding Hou, 1964)**:** *Teijsmann HB 3387*, Sumatra, Bangka Is. (hololectotype U). **Synonyms:** *Wikstroemia acuminata* Merr. *op. cit.* (1921) 417, PEB (1929) 218; *W. clementis* Merr. *op. cit.* (1917) 99, *op. cit.* (1921) 417; Heine *op. cit.* (1953) 69.

Small tree to 10 m tall. **Twigs** light-brown to dark-brown, sparsely pubscent or glabrescent when young, smooth, reddish brown and glabrous when older. **Leaves** membranaceous to chartaceous, glabrous, *drying discolourous*, subolivaceous or light brown and rather shinny above, dirty white or light green, rather dull, sometimes light brown below; blade broadly elliptic or lanceolate, rarely ovate, 6–12 × 1.5–4.5 cm, base cuneate, acute or obtuse, apex acuminate, acumen to 1 cm long; midrib raised on both surfaces; *lateral veins* 7–12 pairs, rather irregular, *curving upwards but not merging into intramarginal veins*, slightly elevated, rarely indistinct on both surfaces; intercostal venation loosely anastomosing, reticulations usually obscure on both surfaces; petiole *c.* 0.4 cm long. **Inflorescences** *usually axillary and occurring in several leaf axils along the branchlets*, sometimes also terminal with bract-like reduced leaves, *1–5-flowered*; peduncle to 1.5 cm long, appressed puberulous. **Flowers** yellowish or cream, subsessile; calyx tube 10–13 mm long, sparsely puberulous outside, glabrescent, lobes ovate-oblong, 2–3 mm long; stamens in 2 whorls, upper whorl sessile or with short filaments, lower whorl short filamentous, anthers linear, 1–1.5 mm long, acute or slightly apiculate; ovary oblong or slightly obovoid-oblong, *c.* 2 mm long, glabrous or sparsely hairy at the top, style very short or sessile, stigma capitate, papillose. **Fruits** ovoid, *c.* 0.8 × 0.5 cm, yellow, green or orange.

Distribution. Sumatra and Borneo. In Sabah, known from Keningau, Kota Kinabalu, Kota Marudu, Pensiangan, Ranau, Sandakan, and Sipitang districts (e.g., *SAN 33737*, *SAN 116514*, *SAN 122192*, *SAN 134388*, and *SAN 139445*) and in Sarawak, from Belaga, Kuching, Lawas, and Miri districts (e.g., *S 39756*, *S 52466*, *S 54115*, and *S 80624*). Also occurring in Brunei (e.g., *van Niel 4299*) and in Kalimantan.

Ecology. In swamp, mixed dipterocarp and lower montane forests, at altitudes to 1600 m.

Uses. The wood is harder than *Aquilaria* and when burn it gives forth fragrance similar to that of aloewood.

APPENDIX

New Dipterocarp Species from Sabah and Sarawak

Hopea obscurinerva P.S.Ashton, ***sp. nov.***

Hopea tenuinervula P.S.Ashton affinis sed lamina coriaceore in sicco roseobrunnescente costis lateralibus utrinsecus 11–14 costis intermediis manifestis costis tertiariis obscuris facile differt. ***Typus:*** *Mohtar S 51417, Borneo, Sarawak, Bintulu district, Ulu Tubau* (*holotypus KEP; isotypus SAR*).

Notes. This new species is closely allied to the group in sect. *Hopea* subsect. *Pierrea* which includes *Hopea pachycarpa*, *H. pterygota*, *H. bullatifolia* and *H. tenuinervula*. It differs from *H. pachycarpa* in its aliform fruit sepals. The dry fallen leaf, thickly coriaceous with obscure intercostal venation, the presence of a few intermediate lateral veins, and the striking pink brown colour serve to distinguish it from all others.

The species is endemic in Borneo and known to date from the lower Tubau R. drainage in Sarawak. It occurs in mixed dipterocarp forest on clay soils, at altitude to 300 m.

Specimens examined: BORNEO, SARAWAK—Bintulu district, Ulu Tubau, *Ashton S 18195* (SAR), *Mohtar S 51417* (KEP, SAR).

Shorea calcicola P.S.Ashton, ***sp. nov.*** (sect. *Shorea*, subsect. *Shorea*)

Shorea scrobiculata Burck vix discrepens, nihilominus lamina late ovata costis lateralibus utrinsecus 9 distincte laxioribus ample differt. ***Typus:*** *Murthy & Chai S 24690, Borneo, Sarawak, Kuching district, 21st mile Kuching-Serian Road* (*holotypus KEP; isotypus SAR*).

Notes. The species is very similar to *Shorea scrobiculata* and *S. atrinervosa* but differs from the former in the broadly ovate leaf blade with *c.* 9 pairs of lax lateral veins and from the latter in its anthers armed with a single apical bristle, non glaucous leaves and lateral veins drying the same tawny-brown as the leaf blade instead of turning black.

The species is endemic in Sarawak and confined to but locally common in forest on organic soils over limestones, at altitude to 400 m.

Specimens examined: BORNEO, SARAWAK—Bau district, Jambusan, *Anderson S 12582* (KEP, SAR), Tai Ton, Bt. Numpang, *Anderson S 22777* (KEP, SAR); Kuching district, 21st mile Kuching-Serian Road, *Murthy & Chai S 24690* (KEP, SAR); Miri district, G. Subis, Sg. Sekaloh, *Sylvester S 27282* (KEP, SAR; tentative record); Serian district, Bt. Selabor, *Ilias S 28041* (KEP, SAR). In addition, there are unconfirmed records comprising sterile specimens collected from limestone hill in the G. Mulu NP, Miri district.

Shorea woodii P.S.Ashton, ***sp. nov.*** (sect. *Pachycarpae*)

Sect. Pachycarpae affinis lobis calycis longiores in fructu aliformes lamina grandis profunde peltata facile distinguita. ***Typus:*** *s.c. A56/36, Borneo, Sarawak* (*holotypus FHO*).

Notes. Named after Geoffry Howarth Spencer Wood, who introduced me to the dipterocarps but whose inspiring stay with me in Brunei ended in tragedy. The species is unique among species of the *Shorea* sect. *Pachycarpae* in having long spatulate larger calyx lobes, deeply peltate leaf base and petiole of 4–7 cm long.

The species which is endemic in Sarawak is currently known only by three collections from Belaga and Kapit districts. It is uncommon and occurs as scattered individuals and small groups in mixed dipterocarp forest on damp sandy clay soils, on hillsides at altitude to 200 m.

Specimens examined. BORNEO, SARAWAK—Without locality, *s.c. A56/36* (FHO); Belaga district, Ulu Rajang, Bt. Alet, Nanga Bah, *S 22318* (K, KEP, L, SAR); Kapit district, Btg. Rajang, Pelagus rapids, *S 17801* (K, KEP, SAR).

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OFMSP

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CLK

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DFPF

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DMT

COMMONLY USED ABBREVIATIONS FOR LOCALITIES

English		Malay	
Word	**Abbreviation**	**Word**	**Abbreviation**
Central	C	Batang	Btg.
Division	Div.	Bukit	Bt.
East	E	Gunung	G.
Forest Reserve	FR	Kampung	Kg.
Hectare	ha	Sungai	Sg.
Island	Is.	Tanjung	Tg.
Mountain	Mt.		
National Park	NP		
North-East	NE		
North-West	NW		
River	R.		
South	S		
South-East	SE		
South-West	SW		
West	W		

PLATES

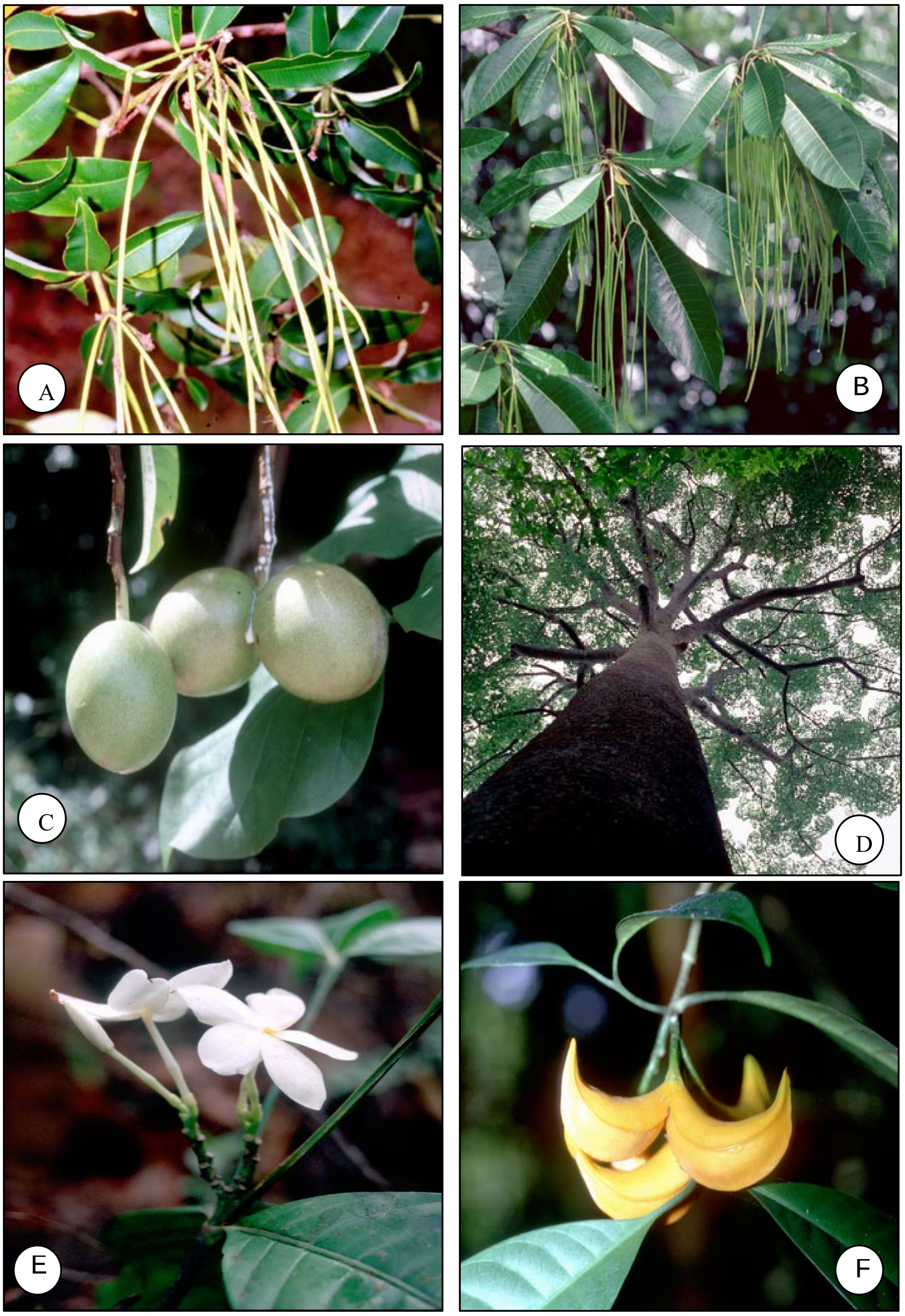

Plate 1. **Apocynaceae:** A, *Alstonia iwahigensis*; B, *Alstonia macrophylla*; C, *Cerbera odollam*; D, *Dyera costulata*; E, *Kopsia pauciflora* var. *mitrephora*; F, *Tabernaemontana pauciflora*.

(Photo credits: A = J.T. Pereira; B–C = E. Soepadmo; D–F = L.G. Saw).

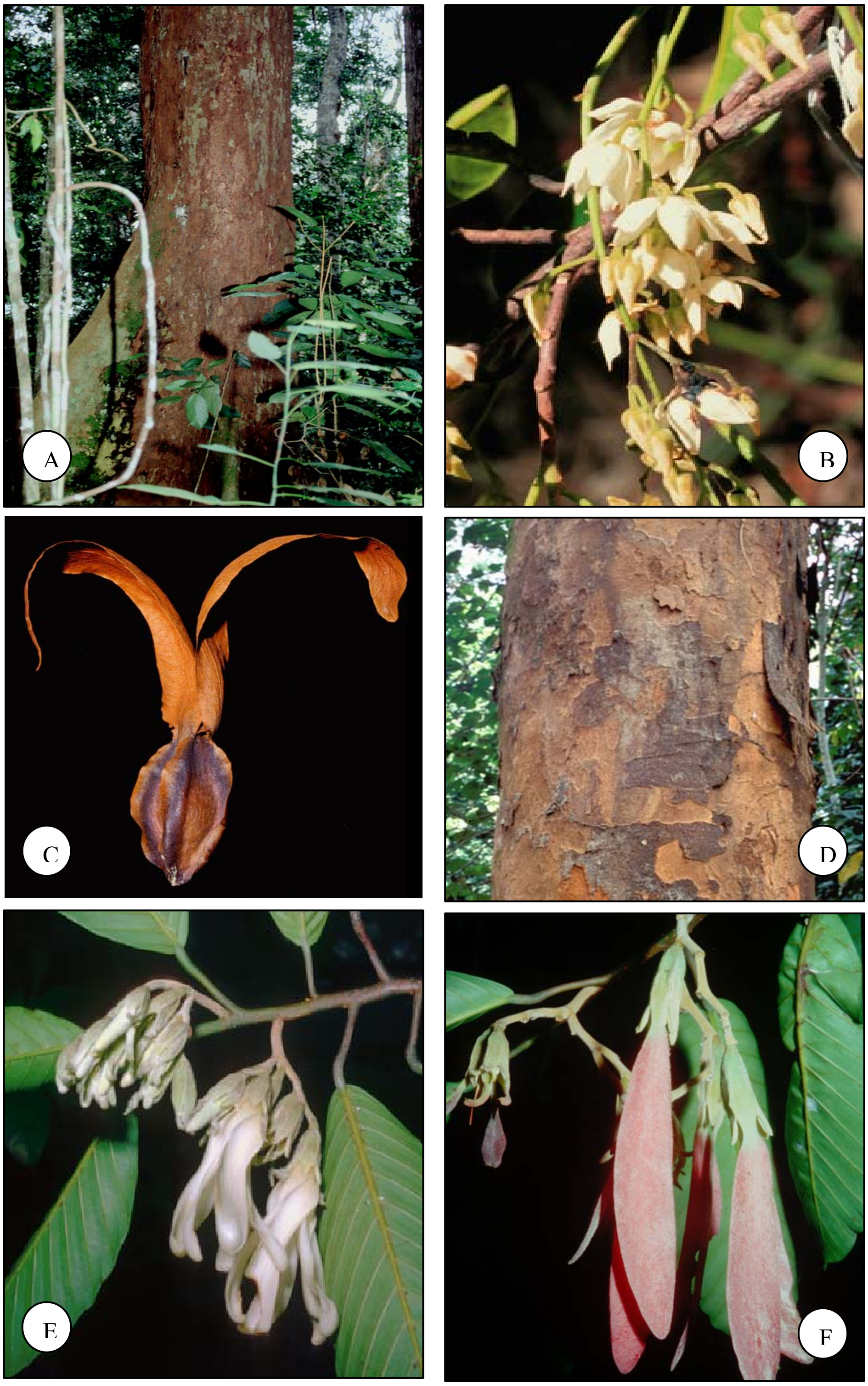

Plate 2. **Dipterocarpaceae:** A–B, *Anisoptera reticulata*; C, *Dipterocarpus grandiflorus*; D–F, *Dipterocarpus oblongifolius*.

(Photo credits: A–B = E. Soepadmo; C = L.S.L. Chua; D = L.G. Saw; E–F = E. Soepadmo).

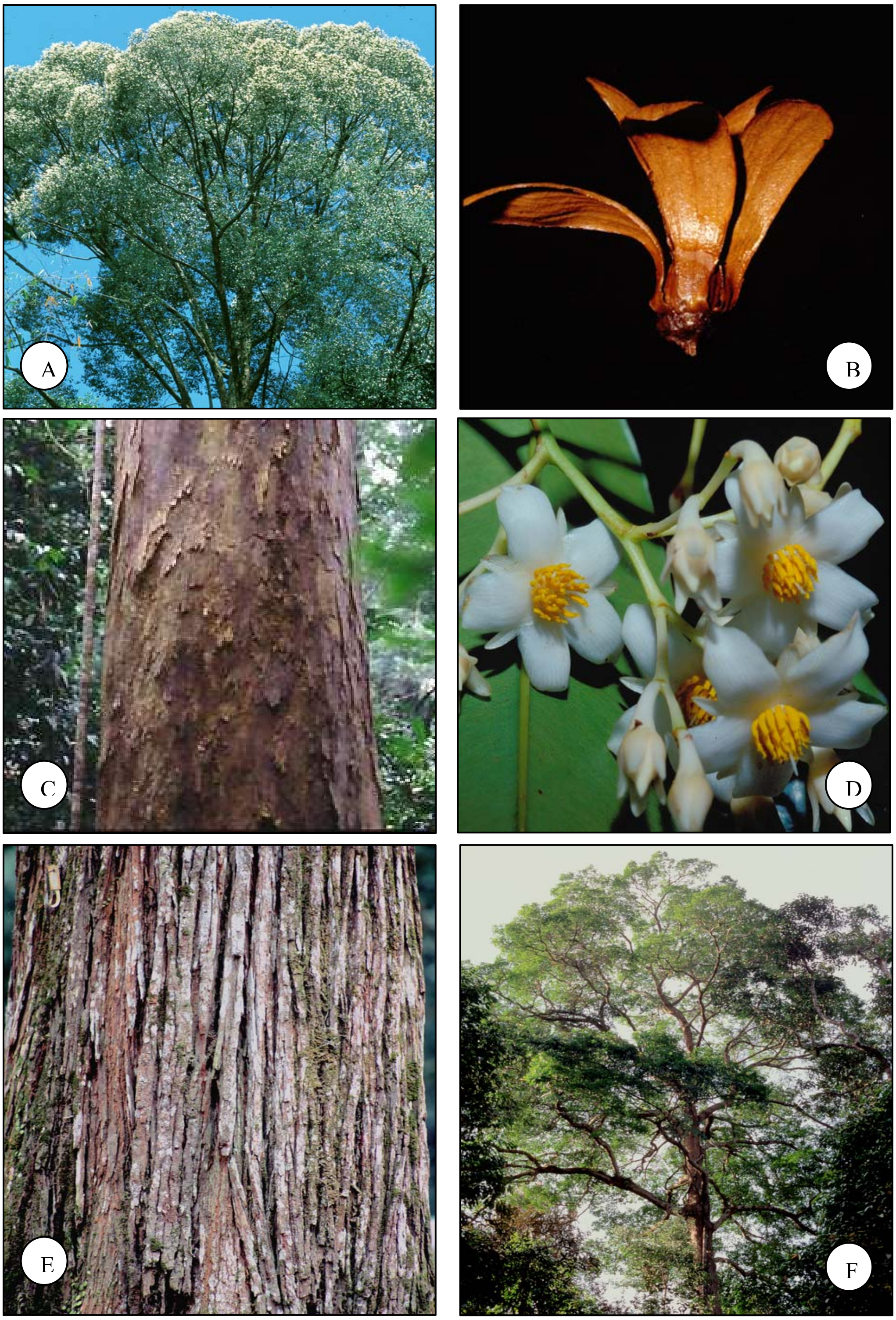

Plate 3. **Dipterocarpaceae:** A–B, *Dryobalanops aromatica*; C, *Dryobalanops beccarii*; D, *Dryobalanops oblongifolia*; E, *Hopea beccariana*; F, *Shorea coriacea*.

(Photo credits: A = H.S. Yong; B = L.S.L. Chua; C = Stephen Teo; D = L.S.L. Chua; E–F = L.G. Saw).

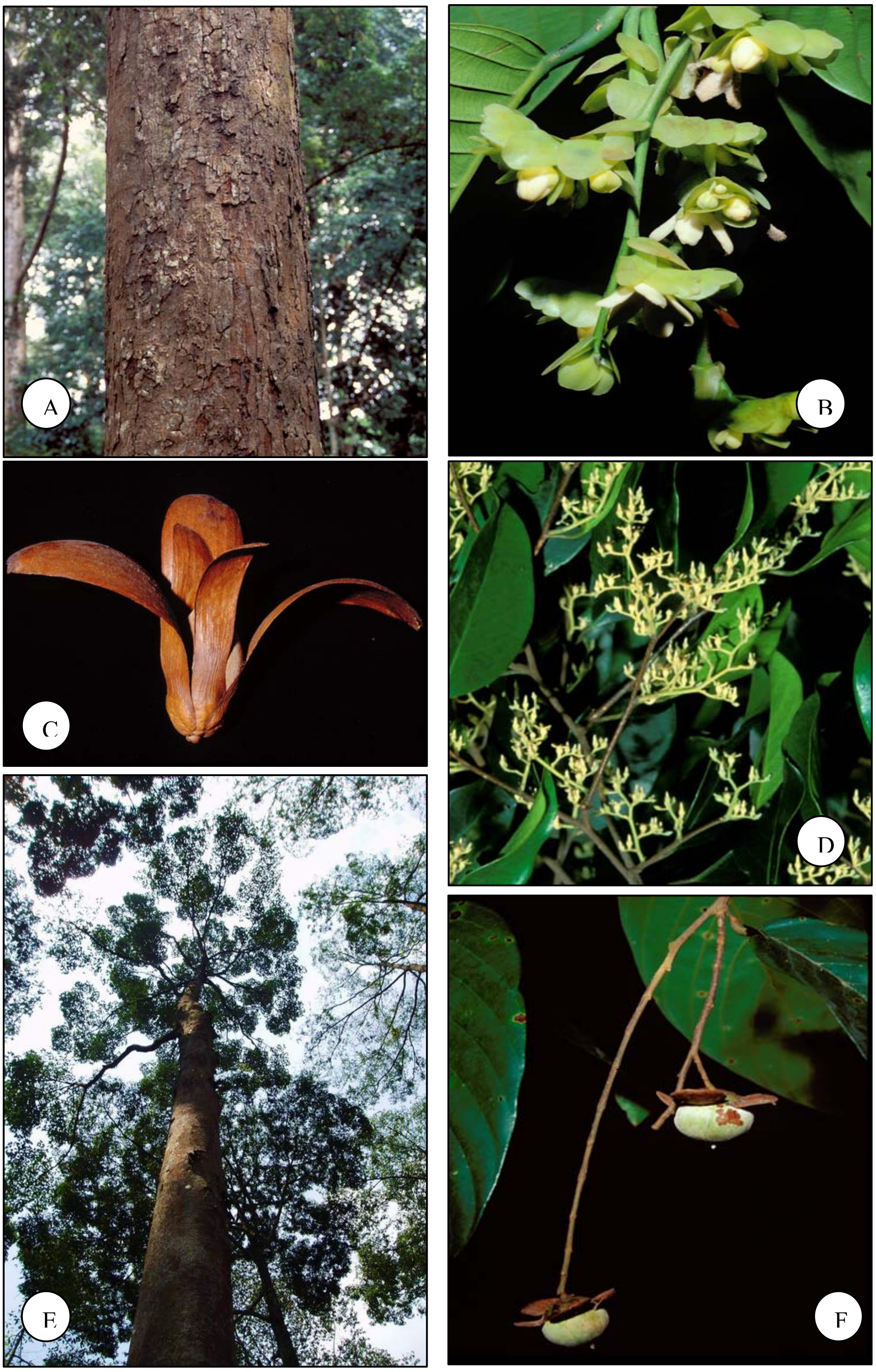

Plate 4. **Dipterocarpaceae:** A, *Shorea exelliptica*; B–C, *Shorea macrophylla*; D, *Shorea multiflora*; E, *Shorea rotundifolia*; F, *Shorea seminis*.

Photo credits: A = L.G. Saw; B–D = L.S.L. Chua; E = W.K. Soh; F = L.S.L. Chua).

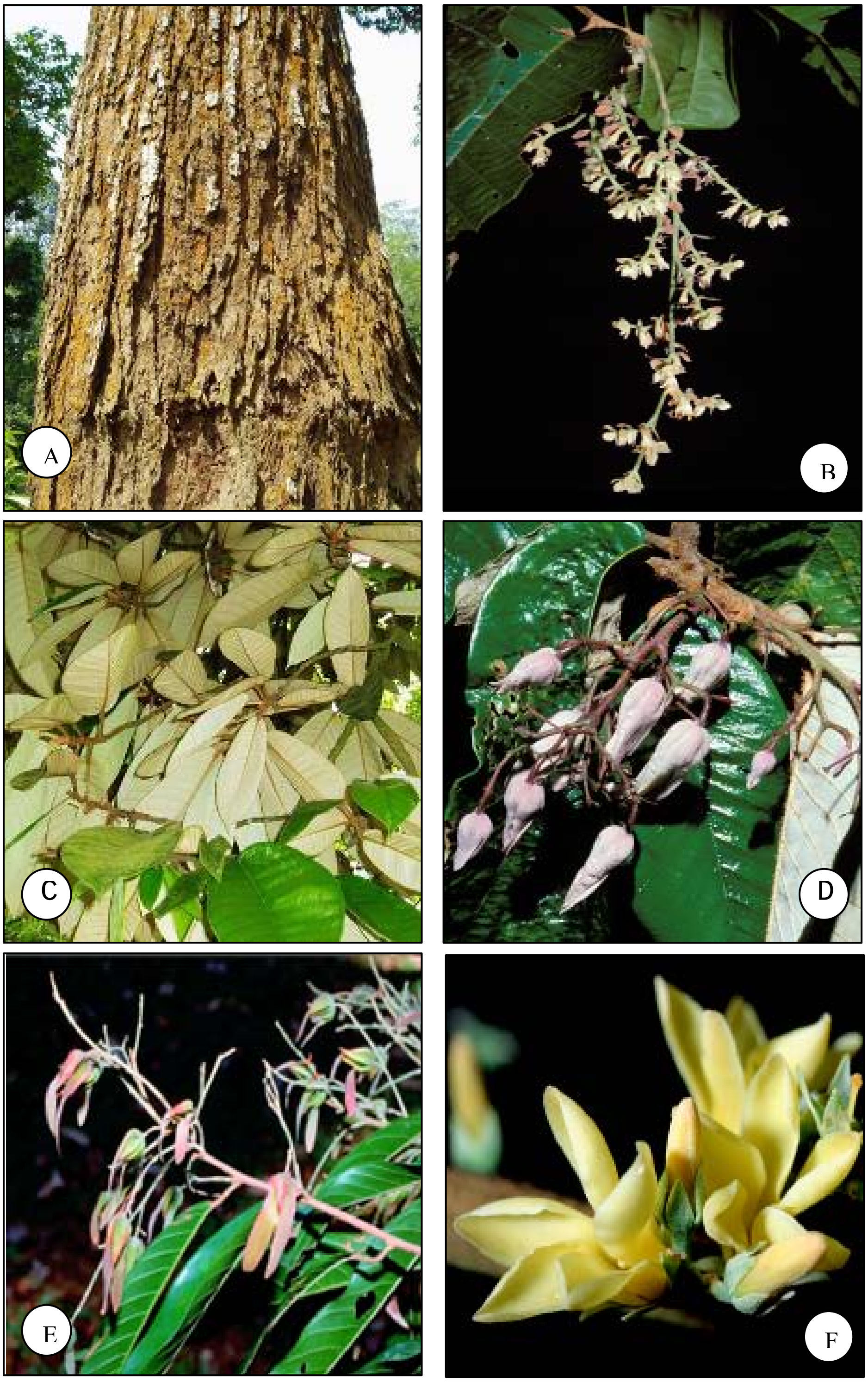

Plate 5. **Dipterocarpaceae:** A–B, *Shorea smithiana*; C–D, *Upuna borneensis*; E, *Vatica nitens*; F, *Vatica odorata*.

(Photo credits: A = W.K. Soh; B = L.S.L. Chua; C = W.K. Soh; D–F = L.S.L. Chua).

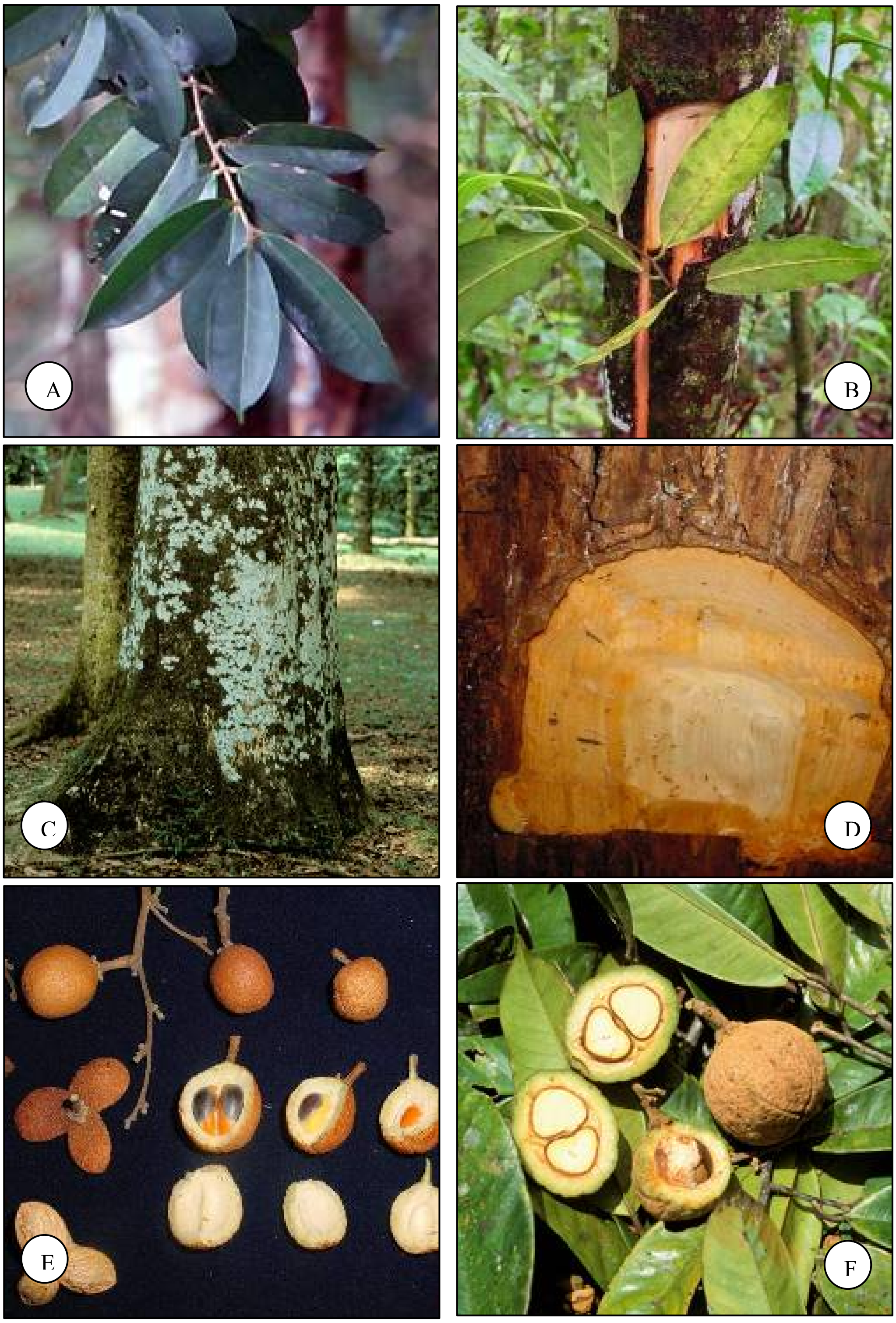

Plate 6. **Thymelaeaceae:** A, *Aëtoxylon sympetalum*; B, *Amyxa pluricornis*; C, *Aquilaria malaccensis*; D–E, *Gonystylus forbesii*; F, *Gonystylus macrophyllus*.

(Photo credits: A = Stephen Teo; B = C.S. Tawan; C = L.G. Saw; D–E = C.S. Tawan; F = E. Soepadmo).

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(*compiled by S. Julia & W.K. Soh*)

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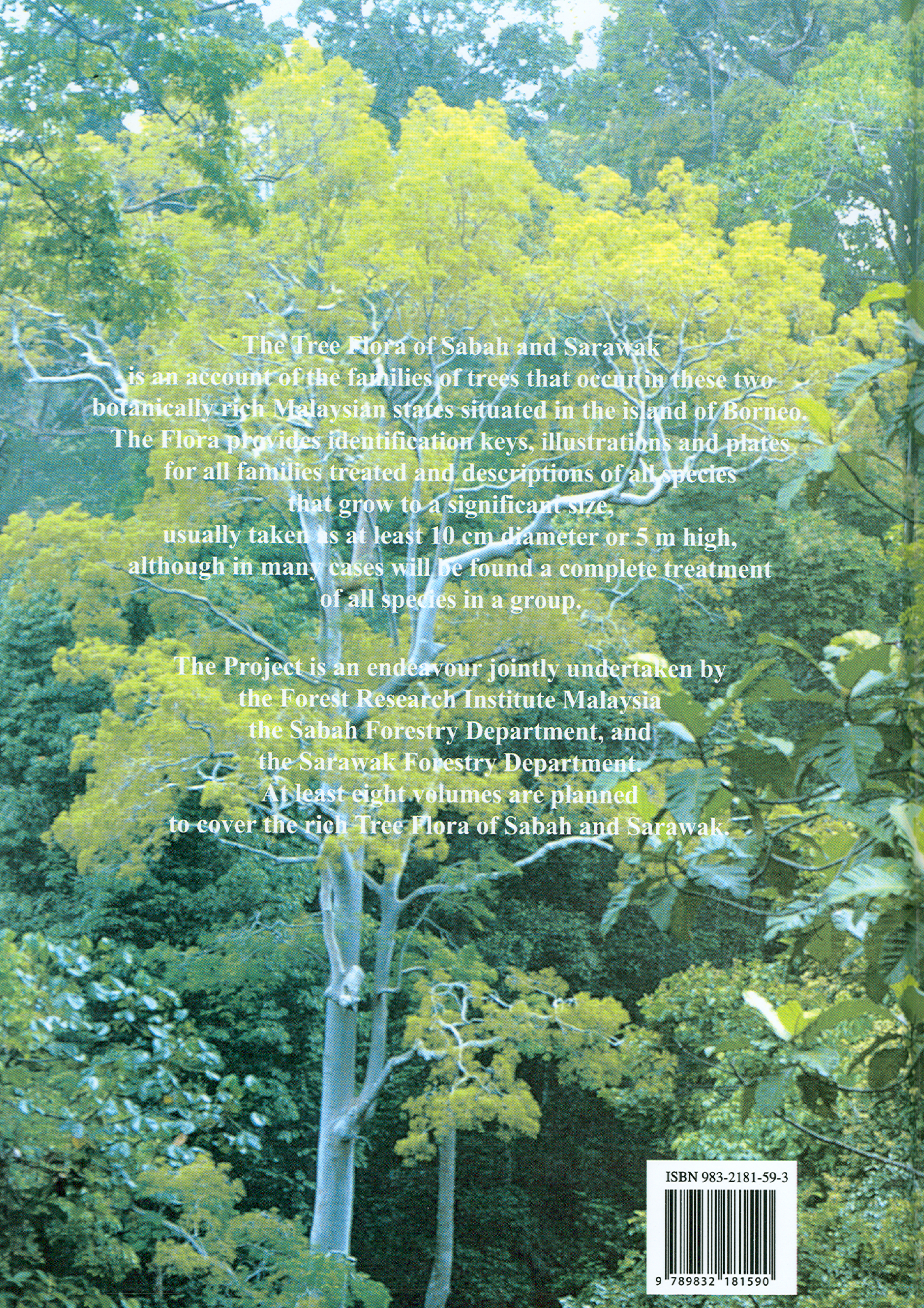

The Tree Flora of Sabah and Sarawak
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botanically rich Malaysian states situated in the island of Borneo.
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for all families treated and descriptions of all species
that grow to a significant size,
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